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ELECTRICAL TRANSMISSION UNDER LAND AND WATER.

In this issue of the ELECTRICAL REVIEW, Mr. Alton D. Adams has an interesting article on the use of cables in electrical transmission. It sometimes happens in a transmission system that a body of water lies between the power-house and the point of delivery. If it is impracticable to go around this, it must be crossed either by an overhead span or by means of a submarine cable. Transmission systems delivering electrical energy to towns are frequently required to lay their lines underground. We thus have two cases where a high-voltage cable is necessary or desirable. Mr. Adams discusses a number of typical instances of this work, showing what has been done, and what may be considered conservative practice to-day. Two of these systems may be mentioned. The celebrated Deptford-London system has been in operation at 11,000 volts for over twelve years. The highest voltage mentioned on underground cables conveying energy for light or power is 25,000. This is on the Apple River system, delivering power to St. Paul, Minn.

THE TELEPHONE ENGINEER.

As the demand for increased and improved telephone service continues the opportunity for the telephone engineer becomes more and more apparent. Within the past year, at numerous meetings and conventions of engineering bodies, the need of exceptional skill and information to bring success in this field has been emphasized. The telephone engineer must be many kinds of an engineer, and, with the sharp competition which mechanical systems threaten to bring about, the guiding mind of the manual system must be accurate and painstaking, clever and courageous.

The Expanding Service.

Not alone must the telephone engineer understand the design of his transmitting apparatus, the fitting and construction of his switchboards and intermediaries, but his knowledge must be so broad that he can intelligently cope with outside influences which are crowding him more and more as his exchange service expands.

While the operation of the telephone proper conforms entirely to a study of the phenomena of light currents and low potentials, the telephone engineer must understand and guard against the effects of extraneous high-tension currents which are ever present and adjacent to the exchange of any magnitude. The effects of static disturbances have always been a part of the telephone engineer's problem, and the proximity of high-tension circuits has complicated an already bad condition.

Central Energy.

With the conversion of local battery systems to the central energy scheme of distribution has come the motor-generator and storage battery. This requires, then, a further knowledge of machinery and of secondary batteries, with the complementary skill in designing power boards, distributing circuits and economical connections, to say nothing of the additional cleverness necessary to conduct proper tests and locate trouble.

Construction—Underground and Overhead.

The popular demand for underground construction brings with it the necessity of a proper knowledge, on the part of the telephone engineer, of conduit construction and the design of subways; and, while it is probably not his work, but that of the manufacturer, he must also consider improvements in insulation, in telephone cables, and in the design of various auxiliaries.

The past year has witnessed a steady increase in telephone construction. There has been incorporated in almost every state in the Union an average of a dozen telephone companies each week. Many of these never get further than incorporation, and many others are merged with existing companies before actual installation has commenced. The decision in the Berliner case did a good deal to establish the stability of independent telephone securities, but there is a very evident decline in the number of new companies, this being largely due to the rational view which has been taken at recent conventions, checking the promiscuous establishment of exchanges in small towns.

Standardization.

There is a growing tendency among manufacturers of telephone apparatus toward standardization, and little change is noticeable in the apparatus of prominent makers. The demand for party-line service has created an attractive field for selective signaling and lockout systems, and high-current ringers for heavily loaded lines. One manufacturer has put in operation several multiple switchboards with a capacity of 18,000 lines on three-tenths-inch jacks, which are said to be giving excellent service; another manufacturer is fitting multiple boards with 200-line equipments and these are being handled with satisfaction. There will

shortly be afforded an opportunity to witness the working of the automatic system on an extended scale, as the manufacturing company has announced the completion, at an early day, of a 6,000-line installation.

THE UTILIZATION OF ALUMINUM IN THE GOLDSCHMIDT WORKS AT ESSEN.

According to a recent article by Danneel in the *Zeitschrift für Elektrochemie*, the consumption of aluminum by the Allgemeine Thermit Gesellschaft, at Essen, is rapidly increasing, and this company is now drawing its supplies of the light metal not only from Neuhausen, but also from France and America. Our readers are doubtless well acquainted with the principles of the Goldschmidt process for reducing the metallic oxides of the rare metals, and for welding joints, by aid of powdered aluminum. The application of the Goldschmidt procedure to the welding of tramway rails has more than once received notice in our columns, and it is unnecessary to repeat the information already given under this head by Danneel. Some of the facts relating to the production of metals and alloys, given by the latter, are, however, new, and may be of interest to our readers. At the Dusseldorf, 1902, exhibition, the Allgemeine Thermit Gesellschaft showed specimens of the following metals and alloys, all produced at the Essen works by reduction of the corresponding oxides with powdered aluminum:

Chromium, free from carbon, testing	98–99 per cent Cr.
Manganese, free from carbon, testing	98–99 " " Mm.
Manganese copper, manganese tin and manganese zinc alloys.	
Ferrotitanium alloy, containing	20–25 per cent Ti.
Manganese titanium alloy, containing	30 " " "
Ferroboron alloy, containing	20–25 " " B.

Chrome Alloys.

The carbon-free chromium is reported to be now extensively utilized in steel works for the manufacture of hardened tool steels, an addition of five to seven per cent of Cr, with a small percentage of tungsten, being employed for this purpose. The carbon-free chromium is also used largely in the manufacture of chrome-steels containing only a small percentage of the former metal—the alloy in these cases being designed for the manufacture of cannon, locomotive pins and bolts, and similar articles.

Applications of Thermit.

As regards thermit, the use of this trade mixture of powdered aluminum and ferric oxide is rapidly increasing, and it is coming into use in foundries and engineering establishments for the quick repair of broken or defective castings.

FALSE ECONOMY IN TELEPHONE SERVICE.

The New York & New Jersey Telephone Company has had occasion to remove a number of telephones from schoolhouses and police courts in the municipality which its system covers on Long Island on account of the refusal of the city to pay for this service.

No Economy.

The action of the city is based on a plea of economy. Economy and thrift are attributes of clear-headedness and accomplished husbandry, and are worthy of emulation. These conditions are very commendable in the practice of municipal government. But is this economy justified, and is there any thrift in saving of money if valuable time is to be wasted? For is not time truly wasted if we fail to take advantage of every means for legitimately hastening the process of government and making use of the speediest and most accurate means for the transaction of business?

Pupils Will Suffer.

The public schools should stand, first of all, for the dissemination of intelligence, and under the conditions now existing, especially in the districts under consideration, there is no time to lose in properly and promptly taking care of any contingency that might arise to deprive the pupils of a public school of competent instruction. Should a regular preceptor be absent, there is always available substitute teachers, and it was the chief function of these telephones to place the principal of any school thus situated in prompt communication with the proper source of supply.

Police Courts Handicapped.

In the police courts affected the same conditions prevailed. There has been no innovation ever introduced which has so materially lessened the burden of detail and hastened the orderly process of government than has telephonic intercommunication between these municipal departments.

No Logic in the Situation.

Economy is a good thing. That is, real economy. But where economy means a retrogression to the very conditions which prompted the original advance, the logic which is back of it seems to be conspicuous in its absence.

VELOCITY OF OBJECTS FLOATING IN RUNNING WATER.

A recent issue of the *American Machinist* contains a communication from Mr. Howard A. Coombs, under the above caption, which quotes from a letter of Brigadier-General Sir Samuel Bentham, recounting how he was converted, against his original conviction, to the belief that objects of different weight and shape, floating in running water, travel at different speeds, which are frequently greater than that of the water itself.

The Explanation Offered.

It is unnecessary to quote the whole communication, which describes some experiments made by Sir Samuel, in which he found that a large vessel with a shallow draft was carried more swiftly down a river than a small boat and other objects floating on the stream. Sir Samuel gives the following explanation:

Rivers consist of water running down an inclined plane by the force of gravity. Were it not for the resistance the water meets with in the bed of the river, as well at the bottom as at the sides, the water would run down infinitely faster. Bodies floating on this running water are acted upon also by the force of gravity; they have a tendency to move with as great a velocity as that which the water itself would have, had it met with no resistance against the bed of the river. These floating bodies do not touch the bed of the river; their motion is not impeded, until we come to consider the resistance they meet with in the water itself. But they meet with none till their motion exceeds that of the water. Their motion then must exceed that of the water and the more so the less they are affected by that resistance; hence, the better their shape is adapted to divide the water, and the greater proportion their gravity bears to the surface of resistance, the quicker they will be impelled by their gravity through the medium

which tends to retard their motion. They would acquire, were it not for the resistance they meet with from the water, precisely that degree of velocity, which the water itself would acquire, were it not for the resistance it meets with from the land.

An Editorial Comment.

Commenting upon this, the editor of the *American Machinist* says:

If a wheeled weight were placed upon an inclined plane it would move down the plane regardless of whether the plane were in motion or not. This is substantially the condition of the body floating down a stream, and it seems to us the position taken is incontestable.

A Particular Case.

In the above quotations no mention is made of the effect of air currents or air resistance at the surface of the water, so that we may neglect these. As we have not made any experiments to test this phenomenon, we will assume that Sir Samuel's premise is correct, and that the vessel does move faster than the water. Let us replace the wooden vessel by a block of ice having the same shape and the same weight as the vessel. There seems to be no reason why this should not move with the same velocity as the wooden vessel, since it will displace the same volume of water, and will be attracted toward the earth with the same force. Now, let us assume that the block of ice has melted, and the resulting water has reached the same temperature as the river water. It will still occupy the original space in the river, and still have the same weight, and it therefore should continue to move down stream at a greater rate than the water surrounding it. This conclusion seems absurd, and to the objection that the fluid may behave differently from a solid, we can assume the water to be surrounded by a weightless membrane, retaining it in its original shape. We will still be occupying the untenable position that a certain body of water within the stream is urged forward with a greater force than that of the water surrounding it.

All Forces Acting Must Be Considered.

It is not correct to state merely that the floating body is drawn down the stream by the action of gravity. The body is forced forward by the resultant of the force of gravity and the upward push of the river, which push is equal to the weight of the water displaced, and is normal to the surface of the river, and therefore has a component acting down stream. Every particle of water in the stream is acted upon by a similar force, and there can therefore be no tendency to drive a floating object forward at a speed greater than that of the surrounding water.

A Possible Explanation.

As stated specifically above, the effects of air currents and air resistance were neglected, although the latter undoubtedly retards the surface water somewhat, so that the maximum speed of flow will be found somewhere below the surface. This might account for the results obtained by Sir Samuel.

METHODS OF COMBINING RESISTANCES—I.

BY EDWIN F. NORTHRUP.

Various methods have been proposed and employed for combining resistance coils in resistance boxes for obtaining given values of resistance. We propose to summarize the methods which have been used, and to describe some new useful ones. Some general remarks may first be made on the general methods of forming combinations of resistances, condensers, self-inductances, or other portions of electric circuits.

FORMULAE AND GRAPHICAL REPRESENTATIONS OF COMBINATIONS.

If we have n things, these can be combined, m in a group, to form C_m combinations, where

$$C_m = \frac{n\,(n-1)\,(n-2)\,..\,(n-m+1)}{\lfloor m} \qquad (1)$$

Multiply both numerator and denominator of the right-hand member of (1) by $(n - m)!$ and the result is

$$C_m = \frac{n!}{m!\,(n-m)!} \qquad (2)$$

Equation (2) shows that the number of combinations of n things, m in a group, is the same as the number of combinations of n things in groups of $(n - m)$.

The total number of combinations of n things taken singly, two in a group, three in a group, etc., is

$$C_T = 2^n - 1 \qquad (3)$$

The proof of the above formulæ can be found in any advanced algebra.

The formulæ (1), (2) and (3) give the groups that can be formed of n things. If each of these groups is made up of portions of electric circuits, such as resistance coils, coils of self-inductance or

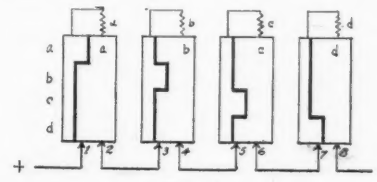


FIG. 1.

condensers, the different members of each group can be joined together by being connected in series, in parallel or in mixed arrangements. Thus, if we have n coils, the total number of combinations that can be formed by joining these coils in series is

$$T_s = 2^n - 1 \qquad (4)$$

If the same coils are joined in parallel we can also form $T_p = 2^n - 1$ combinations.

Since, however, the coils used singly are the same for series and for parallel arrangements, we have as the total number of combinations possible, with connections differently arranged, for n coils joined in series and in parallel,

$$N = 2^n - 1 - n + 2^n - 1 \quad \text{or}$$
$$N = 2^{n+1} - (n + 2) \qquad (5)$$

The above formulæ can be illustrated graphically, and the graphical illustrations will show how to construct some interesting and practical devices for combining electric circuits.

Fig. 1 graphically illustrates the combination of four things as *a, b, c* and *d*, taken in groups of 1. *a, b, c* and *d* may be taken as resistances, and 1 to 8 brushes, which are joined in the manner shown, and are assumed to move from the top to the bottom of the diagram. The diagram may be considered as representing the surface of a commutator which is shown developed. When the line of brushes is opposite *a*, the coil or resistance *a* is in circuit, when opposite *b*, *b* is in circuit, etc.

Fig. 2 graphically illustrates the combination of the same four things taken in groups of two. Thus, when the line of brushes is opposite *a b*, the resistances *a* and *b* are in circuit, being connected in series; when the line of brushes is opposite *a c*, the resistances *a c* are in circuit, and so on until when the line of brushes is opposite *c d*, the resistances *c d* are in circuit. Thus the brushes in passing from *a b* to *c d* have successively connected in

series in groups of two, all the combinations of coils that can be made out of the coils *a, b, c* and *d*. Fig. 3 similarly illustrates the arrangement of the commutator surfaces for joining in series the four coils in all the possible combinations

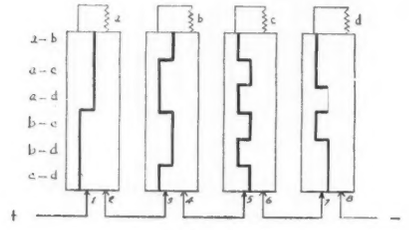


FIG. 2.

of three in a group and finally Fig. 4 shows the commutator surface which will give the four coils connected in series in a single combination of four in a group.

Figs. 1, 2, 3 and 4 graphically illustrate the formula (1) or (2) in which $n = 4$, and m has the value first 1 then 2, then 3, and then 4.

If we now piece together the different sections of the commutator surfaces, illustrated by Figs. 1 to 4, and add an additional section representing none of the coils in circuit, a set of commutator sur-

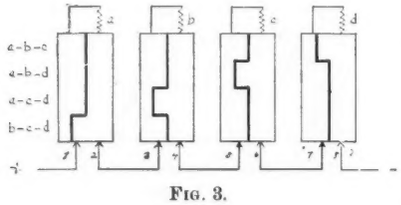


FIG. 3.

faces like that represented in Fig. 5 is derived. The symmetry of the arrangement is apparent. As the brushes 1 to 8 pass over the entire surface of the commutator represented developed in Fig. 5, all possible combinations of the coils *a, b, c* and *d* connected in series are formed. This commutator illustrates formula (3),

$C_T = 2^n - 1$ modified to read $C^1_T = 2^n$.

The same result is obtained if the coils are connected between the pairs of

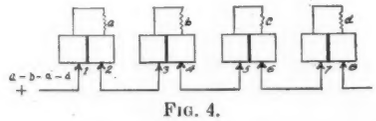


FIG. 4.

brushes, as shown in Fig. 5 in dotted line. For example, when the brushes stand opposite *b, c* and *d*, the coil *a* is short-circuited, while the coils *b, c* and *d* are in circuit.

A slight modification of the connections enables us with a similar set of commutator surfaces to form all the possible combinations of four things, as either four resistances or four condensers, joined in parallel. Fig. 6 illustrates this

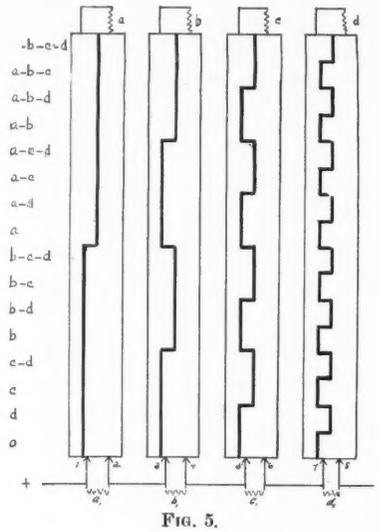


FIG. 5.

case, the cross-sectioned portions representing insulation.

Referring to Fig. 5, it is apparent that each commutator surface is exactly like the one to the left, except that it has twice the number of segments. It becomes possible, therefore, to make all the commutator surfaces similar to the one on the extreme left, and to form in succession all the possible combinations of the four things by giving to the different commutators different speeds. This case is illustrated in Figs. 7 and 8. In Fig. 7, A, B, C and D are four commutator surfaces (shown developed) which are precisely alike. If

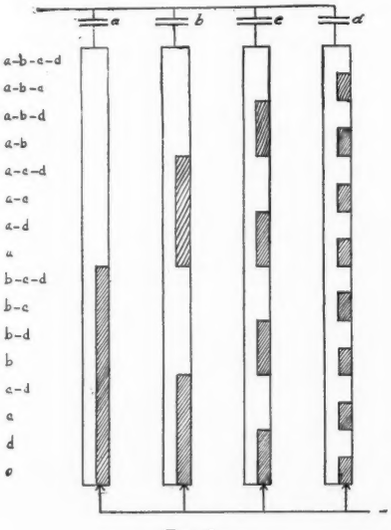


FIG. 6.

commutator A turns with a speed 1, commutator B with a speed 2, commutator C with a speed 4, and commutator D with a speed 8, then if the four resistances *a, b, c* and *d* are connected between the brushes 1 to 8, as shown, these resistances will be connected in series in all possible combinations, and once in each revolution of A all are short-circuited. If the connections are made, as shown in Fig. 8, with the kind of commutator sur-

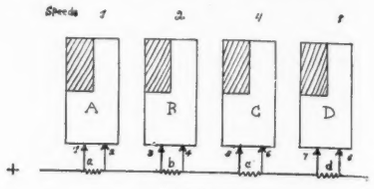


FIG. 7.

faces there shown, all possible combinations of condensers (or any other elements of a circuit) are formed, connections being made in parallel. The method is capable of indefinite extension. Thus, if there are n letters, or commutators, counting the speed for the first letter

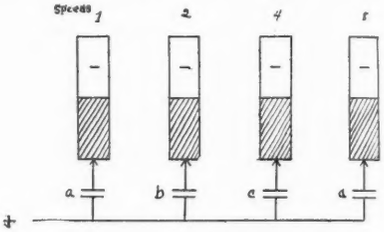


FIG. 8.

unity, the speed for the commutator representing the nth letter is 2^{n-1}.

It is now possible to form a very generalized commutator which will give all possible combinations of n things joined

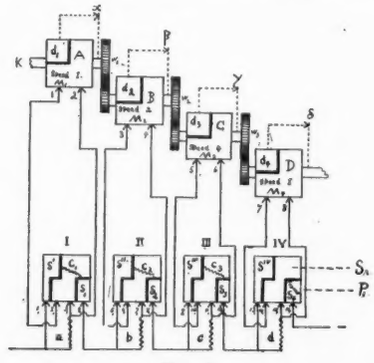


FIG. 9.

Generalized commutator for all possible combinations of n circuits in series and in parallel. Segments d_1, d_2, d_3, d_4 are joined to the frame; segments M_1, M_2, M_3, M_4 are insulated; S^I is connected to S_1 by C_1; S^{II} is connected to S_2 by C_2; S^{III} is connected to S_3 by C_3; S^{IV} is insulated and S_4 is connected to frame. W_1, W_2, W_3 are pairs of gear wheels which give the proper relative speeds to the commutators K to K_1. Brushes 1_1 to 16_1 give series combinations when opposite S_1, and parallel combinations when opposite P_1.

first in series and then in parallel. Fig. 9 illustrates such a commutator for making all the possible combinations of four resistance coils, *a, b, c* and *d*. The com-

mutators lettered A, B, C and D are for forming the combinations. These commutators are shown connected together by a train of gears so as to give to each the proper speed. The commutators I, II, III and IV are small subsidiary commutators, which by being given at any time a half revolution change the connections of *a, b, c* and *d* from series to parallel. This commutator can be still further generalized by making use of relays or switches, α, β, γ, δ, shown in dotted line. According as these relays are

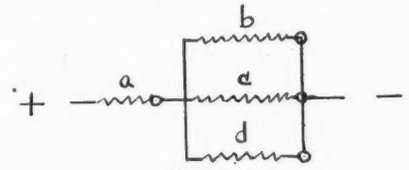


FIG. 10.

open or closed, a great variety of circuits can be thrown in series, and these in series with others in parallel. Thus with α open, β, γ, δ closed and the commutators A, B, C and D in the position shown in the diagram, *a, b, c* and *d* are connected as shown in Fig. 10.

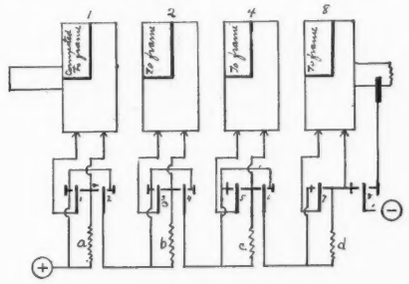


FIG. 11.

Generalized commutator for giving all possible combinations of *n* things in series connection and in parallel connection. 1 to 8 are relay tongues. Tongues to left give series. Tongues to right give parallel.

Fig. 9 represents the generalized commutator in a semi-diagrammatic way. The surfaces of these commutators are supposed to be made of metal, the heavy lines representing the insulation which sepa-

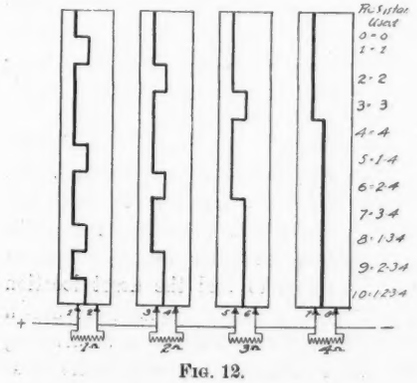


FIG. 12.

rates the different segments. If the surfaces of the combining commutators A, B, C and D were developed, they would show the same arrangement of segments, appearing in fact like the commutator surfaces shown in Fig. 7. The segments M_1, M_2, M_3 and M_4 are entirely insulated, while the segments d_1, d_2, d_3 and d_4 are either connected to the frame, as well as the segment S_4, of the commutator IV, or are joined through the aid of slip rings directly to the segment S_4 of commutator IV. When the brushes 1_1 to 16_1 bear on the change-over commutators I to IV, opposite S_r, the resistances *a, b, c* and *d* will be connected in all possible series combinations, as the commutator A makes one revolution and the others make their corresponding numbers of revolutions. If the brushes 1_1 to 16_1 be on the commutators I to IV opposite P_1 the same combinations will be given with parallel connections by the revolution of the combination commutator. With a little attention and a reference to Fig. 5 the combinations and circuits can be traced from the diagram Fig. 9.

Fig. 11 is a simplified diagram illustrating how the same results may be ac-

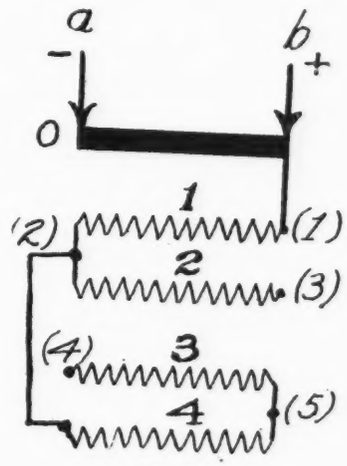


FIG. 13.

complished by using relays to change the connections from series to parallel in place of the change-over commutators I to IV of Fig. 9.

SPECIALIZED COMMUTATORS.

Having developed a generalized commutator, it is easy to form specialized commutators for connecting lamps, resistances, self-inductances, condensers, relays or other parts of electric circuits in any special manner or series of combinations desired. Thus, suppose we wish to obtain, for purposes of forming a regularly increasing series of values of resistance or a decade rheostat, from the coils 1, 2, 3 and 4 ohms the eleven successive values 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 ohms, we can do so by selecting from the generalized commutator, shown in Fig. 5, the portions needed. Doing this we would form a commutator whose developed surface would be like that shown in Fig. 12. An important practical point to notice is, that if the resistances are connected between the brushes as shown in Fig. 12, the brushes at all times remain stationary and the commutator which turns has no wires or sliding contacts, as it consists merely of a device which short-circuits.

The writer has devised a large number of specialized commutators for combining circuits in a great variety of ways. Mention is here made of some forms specially adapted to combining resistance coils to get a greater number of regularly increasing values of resistance than the resistances that are combined. These commutators are specially useful for precision rheostats to be used in connecting with Wheatstone bridges.

The object in forming the commutators in the special manner to be indicated, is to be able to obtain a number of regularly increasing values of resistance from a few coils and with the use of only two brushes or sliding contacts.

The decade, that is, the values 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9, can be obtained by means of a commutator and two brushes from four coils in the following manner. In this method the required resistances are obtained between the two sliders or brushes, which move relatively to the segments of the commutator.

To make clearer the principle employed, reference is made to the diagram Fig. 13. Here 1, 2, 3 and 4-ohm coils are connected in the manner shown. If now two terminals, *a* and *b*, are joined to the point 0 and 1, there will be 0 resistance between these terminals, as the bar B, which is assumed to have 0 resistance, merely connects together the terminals. If *a* is joined to the point (2) and *b* to the point (1), there will be one ohm between *a* and *b*; if *a* and *b* are joined to the points (2) and (3), there will be two ohms between *a* and *b*. In this manner the values 0 to 9, inclusive, may be obtained. The table below gives the pairs of points to connect the terminals to, for obtaining each value of the decade.

0 = (0 — 1) (or short-circuit)
1 = (1 — 2)
2 = (2 — 3)
3 = (1 — 3) or (4 — 5)
4 = (2 — 5)
5 = (1 — 5)
6 = (3 — 5)
7 = (2 — 4)
8 = (1 — 4)
9 = (3 — 4)

Practical Telephone Engineering.

By William W. Handy.

THE writer will endeavor to set forth in the following articles in as concise a manner as is consistent with the field covered, a general description of the problems that are presented to the telephone engineer in the design and construction of modern telephone plants located in large cities, and will describe the way in which it seems best to consider these problems, and to construct the plants so as to yield the best results for the money invested in them. No attempt will be made to describe in detail the various kinds of apparatus used in the equipment of the exchanges, as to cover this field thoroughly would require a volume. Exchange equipment, however, will be considered briefly, and to an extent sufficient to illustrate what systems modern practice seems to have selected as the best. The articles will deal more thoroughly with the detail construction of the plants outside of the exchanges, such as subway, pole line, cable system construction and subscribers' wiring.

GENERAL DESIGN OF PLANT.

Different problems are met with in most every city, due largely to the shape of the territory covered and the locations of the centres of telephone distribution with respect to each other. These two features require careful consideration in order to determine the number, capacity and the best locations for the exchanges, the location and the size of the underground conduit lines, and the cable systems for both subscribers' and trunk wires between the exchanges. Careful consideration should also be given to the future development of the telephone business and ample provisions made in the design of the plant for future increase of subscribers. The conduit lines in certain places should be made of sufficient capacity to accommodate often many times the number of cables at first installed, other lines should be built of capacity but little more than sufficient for the immediate requirements, as it can be readily determined whether the subscribers will probably increase or decrease in certain localities. Many plants have been laid out by competent engineers who failed to appreciate the future growth of the business, and mistakes have been made which have required large amounts of money to rectify. Due consideration should also be given to the comparative cost of constructing the conduit lines on different streets, as in many instances it will be found more economical, due to expensive asphalt and other paving and the number and location of subsurface construction, to locate the conduit lines on streets which at first seemed to be the least adaptable for economical distribution of cable work. There are a number of other features to be considered which will be discussed in detail in connection with the three following examples of telephone plant construction.

Taking as the first example a city of about 300,000 population, and covering a territory where the business part of the city is located near the centre, the great majority of the subscribers being located in the business district, and the other subscribers gradually decreasing as the outskirts of the city are reached. Fig. 1 illustrates this condition of affairs. It is first necessary to consider the question of the number of exchanges, whether two, three or four, or only one main exchange be provided for. In order to determine this accurately, it is necessary to consider the comparative cost of the plant complete with only one exchange, then with two or more exchanges. To determine this it is best to lay out the subway and cable system for each plant, and estimate the various costs and also to estimate on the various costs of the exchanges for each plant. This question of one or more exchanges is often settled by the fact that a board providing for more than a certain number of subscribers, which practice in recent years seems to limit to about 6,000 ultimate capacity, is to some extent inoperative. In this example, however, where the total number of subscribers is 3,800 with a possible assumed increase to 6,000, one board having an immediate capacity of, say, 4,320 and ultimate capacity of 6,000 could be installed safely, and the question of size of board, with respect to whether it would be operative or not, will not have to be considered.

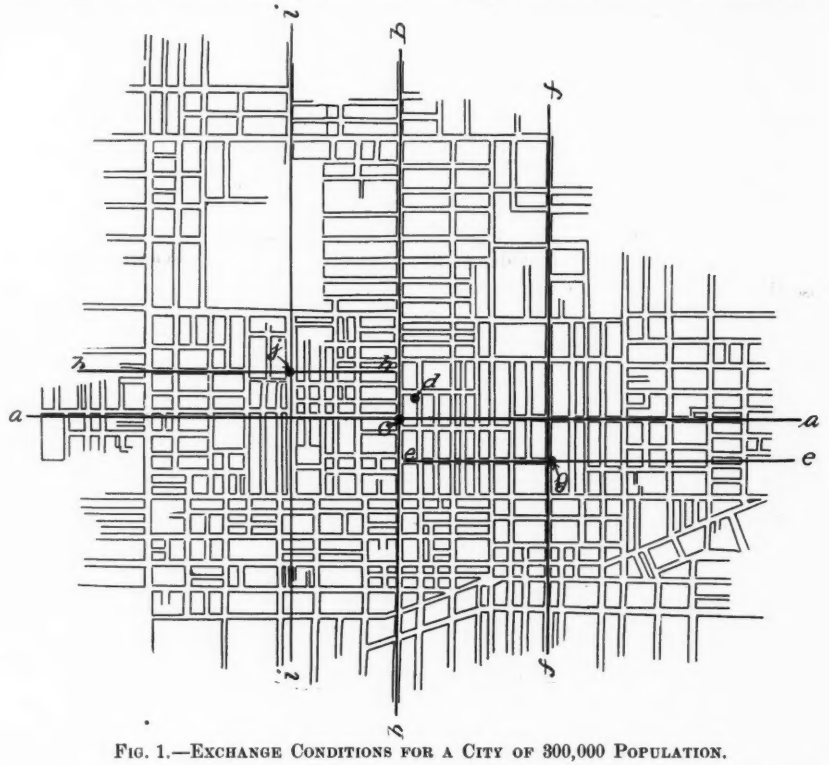


FIG. 1.—EXCHANGE CONDITIONS FOR A CITY OF 300,000 POPULATION.

We will first estimate on the cost for one exchange. In order to locate this exchange at the best point for economical distribution, the total number of subscribers should be counted, which in this example amounts to 3,800 located in the respective blocks as shown. A horizontal line *a a* should then be drawn which would divide the number of subscribers equally above and below the line The exchange should be located somewhere on this line, and to find the exact location for it another line *b b* should be drawn at right angles to the line *a a*, dividing the total number of subscribers also equally on either side. These two lines cross at *c* and at this point the exchange should be located in order to secure the most economical subway and cable distri-

bution. There is another matter to be considered, however, in selecting the exchange location, and that is the price of property. It may be found, for example, that a site can be purchased at the point marked *d*, which costs sufficiently less than property at the point *c* to more than balance the extra cost of cable and subway necessitated by locating the exchange at this point; *d* would therefore be the proper place to locate the exchange, and would be selected as the exchange site. The cost of this plant, with one exchange, we will assume amounts to $500,000.

From a first glance at Fig. 1, we would probably say that one exchange located as above described would be the best design, but in order to be perfectly sure of this we should estimate on two exchanges as follows: Divide the city into two districts, east and west of line *b b*, and select exchange sites for these districts in the same way the exchange located at *d* was selected, treating the two districts of the city east and west of line *b b* separately. Referring to the eastern district, first draw the horizontal line *e e*, dividing the subscribers equally above and below, then draw the line *f f*, dividing the subscribers equally on either side; where these lines *e e* and *f f* cross at the point *g* the exchange for the eastern district should be located, the price of property permitting. In the same way for the western district draw the lines *h h* and *i i*, and where these lines cross at the point *j*, the exchange for the western district should be located, the price of property permitting. Assuming that in each district there are 1,900 subscribers, which number may increase to say 3,000, an exchange equipment should be provided for, each exchange having about 2,160 immediate and 3,120 ultimate capacity.

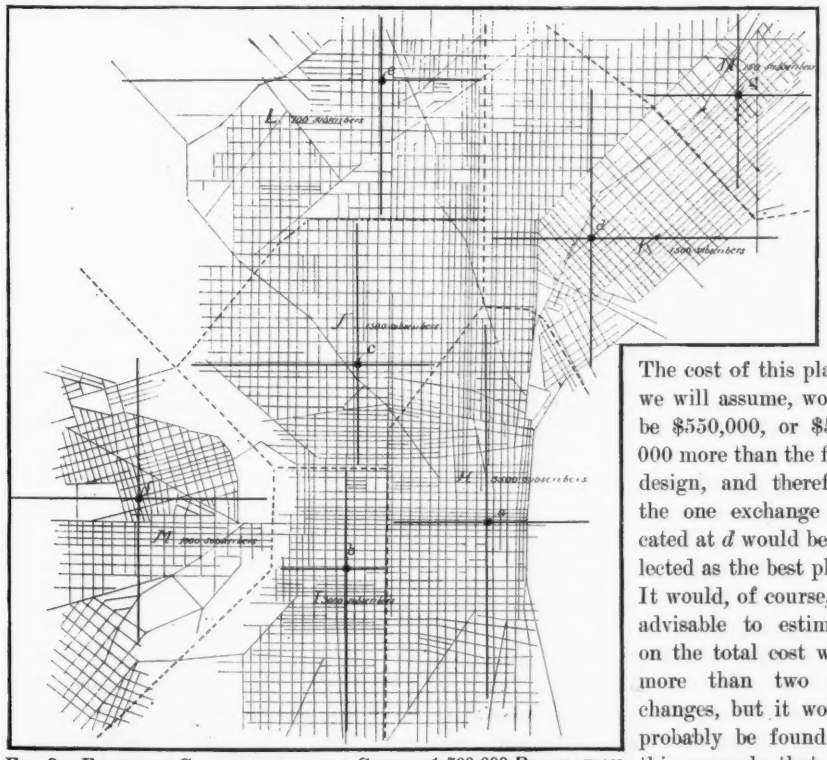


FIG. 3.—EXCHANGE CONNECTIONS FOR A CITY OF 1,500,000 POPULATION.

The cost of this plant, we will assume, would be $550,000, or $50,000 more than the first design, and therefore the one exchange located at *d* would be selected as the best plan. It would, of course, be advisable to estimate on the total cost with more than two exchanges, but it would probably be found in this example that the cost would increase with the number of exchanges.

In general for a plant with a small number of exchanges the total cost of exchange buildings and land is less, altogether each building must be larger than the buildings for a plant with fewer exchanges. The total cost of the switchboards, however, is generally more for a plant with a small number of exchanges, as the cost per drop increases with the capacity of the boards. The cost of cables for subscribers' wires increases as the exchanges decrease in number, but to counterbalance this the cost of trunking cables between the exchanges decreases. The cost of subway increases with a decrease in the number of exchanges. From the above it is readily seen that the question of the number of exchanges should be given the most careful attention.

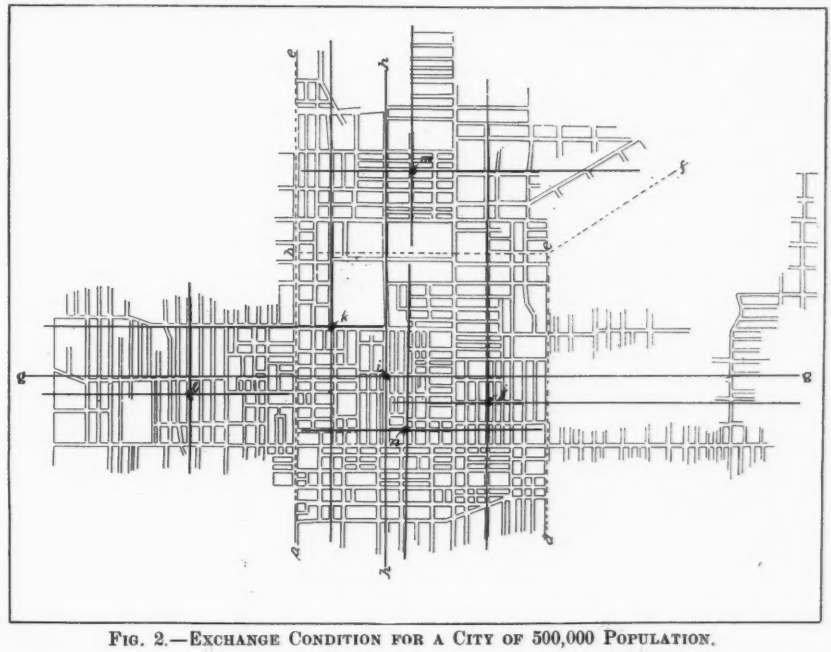


FIG. 2.—EXCHANGE CONDITION FOR A CITY OF 500,000 POPULATION.

For the second example we will assume a city of about 500,000 population, covering a territory as shown in Fig. 2, in which the subscribers are located more irregularly. The city covers a territory much longer than it is wide, the great majority of the subscribers being located in the area enclosed by the dotted lines *a b*, *b c* and *c d*, which is the business district of the city. The total number of subscribers is 5,900. The number located in the business district we will assume is 3,300. West of the line *a b* the total number of subscribers is 500, and they are contained in a comparatively small area. North of the line *b c* and included within the dotted lines *b e*, *b c* and *f c*, the total number is 1,750. The number of subscribers located east of the line *c d* is 350 and these are very much scattered, covering a large area.

(Continued on page 893.)

The Electrical Equipment of the Mersey Railway.

The First Steam Railway Worked Electrically in Great Britain.

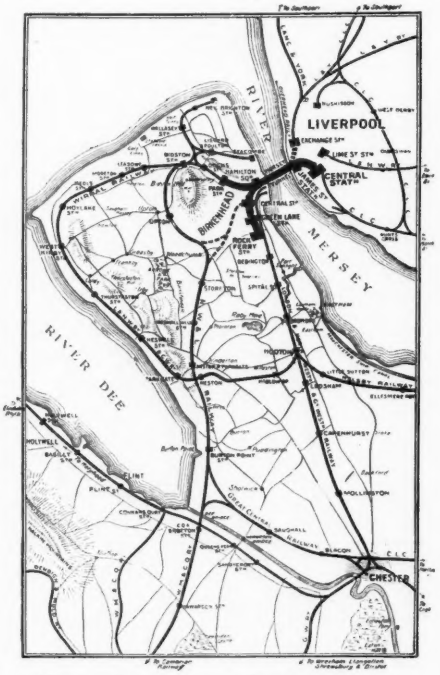
(By Our Special Correspondent.)

A GOOD deal has been written and said on this side concerning the conversion of the Mersey steam railway to electric traction, and a comprehensive account of what has taken place will not be out of place in an American journal. Geographically speaking, the line, as seen on the map, occupies the position of a connecting link between Liverpool and Birkenhead, the only other means of communication being by ferry-boat, except the Runcorn bridge, which, however, is thirteen miles away. As will also be seen on the map, the railway represents a Y, and possesses seven stations.

When first opened to the public, the Mersey railway was largely patronized, but the proper development of the traffic was, from the commencement, prevented by the discomfort and inconvenience consequent upon working by steam locomotives. Upon the company's own statement, the stations, tunnel and rolling stock gradually became more grimy and less attractive, the difficulties caused by the smoke and steam were more and more felt, traffic fell and working expenses remained high. The line was in the hands of the Court of Chancery, and dissensions broke out among the shareholders.

The policy of the company at that time was the object of much criticism, and an agitation took place among the shareholders which resulted in the appointment of an entirely new board. After protracted negotiations a scheme for dealing with the finances of the company was adjusted, and in 1900 an act of Parliament was passed confirming the scheme and providing for the termination of the receivership. At the same time the company was authorized to work the railway by electricity, and to execute the works and raise the necessary capital. In July, 1901, a contract was concluded with the British Westinghouse Company for the construction of the electrical works which have now been concluded. The work of the electrical equipment was carried out without the slightest interruption to the ordinary steam traffic of the railway. The steam working was abandoned at midnight on Saturday, May 2, and on Sunday, May 3, the electrical service was inaugurated. In regard to the train service, the directors decided to maintain a uniform train interval of three minutes from the first train in the morning until the last train at night, believing it wiser to meet the needs of the traffic during the slack hours of the day by reducing the number of cars per train, rather than by reducing the frequency of the service.

As has been indicated, the multiple unit system has been adopted. The trains are formed of two motor cars, one at each end, and either one, two or three trailers, according to the traffic. The present number of vehicles forming the electrical rolling stock of the company consists of



MERSEY RAILWAY AND ITS CONNECTIONS.

twenty-four motor cars and thirty-three trailers, each sixty feet long. Of the motor cars, there are twelve first class and twelve third class, the former having seating capacity for forty-eight passengers, and the latter for fifty passengers. Of the thirty-three trailer cars, eleven are first class, each accommodating sixty passengers, while seventeen are third-class cars accommodating sixty-four passengers each. The remaining five are composite cars, each of which provides seating accommodation for twenty-two first-class and forty third-class fares. Second-class accommodation has been abolished. The cars are all built on the corridor principle, and standing room of more than the seating capacity is given by the wide centre corridor.

At one end of the motor car is the driver's compartment, which occupies from three feet six inches to four feet of the length of the car. Immediately behind is a space set apart for passengers' luggage, taking up a further ten feet of the length. Behind this the whole of the car, with the exception of a small outside platform for a conductor at the rear, is given up for the accommodation of passengers. The space is divided into three compartments, separated by sliding doors, so that a proper proportion of smoking accommodation may be provided with the varying length of the train. The car bodies are of English manufacture, but the trucks, which are of the double type, were built at the Baldwin locomotive works. The cars are, of course, built for standard railway gauge, the truck wheels being all of one size, thirty-three inches in diameter. Four motors of the Westinghouse No. 83 type are fitted to each motor car, one on each axle, coupled to the car axles with the usual single reduction speed gear of the ratio 56.20. The approximate power of each of the motors is 100 horsepower, working at from 550 to 600 volts. They are of the usual enclosed four-pole type, with laminated pole-pieces and slotted core-drum armatures. The collector shoes are carried on stout wooden beams, there being one beam at each end of every motor car secured to the truck frame, and carrying three collector shoes. The two shoes at the extremities of the beam serve for the positive collector, the third shoe being hung from the centre of the beam to form the negative terminal of the car circuit. The shoes are of soft iron, hung by a loose system of simple links from the beam, gravity being depended upon for maintaining efficient contacts between the shoes and the conductor rails. The controllers are all of the Westinghouse No. 134 type. They have magnetic blow-outs, and are arranged for the series parallel control of four motors each. The controllers and the circuit-breakers are equipped with the Westinghouse electropneumatic gear for train operation on the multiple unit system. However this is familiar to American engineers, and therefore need not be described here.

The motorman's compartment is lined throughout with asbestos slate, an absolutely fireproof material, which is also extensively used underneath the car in various places where there is any possi-

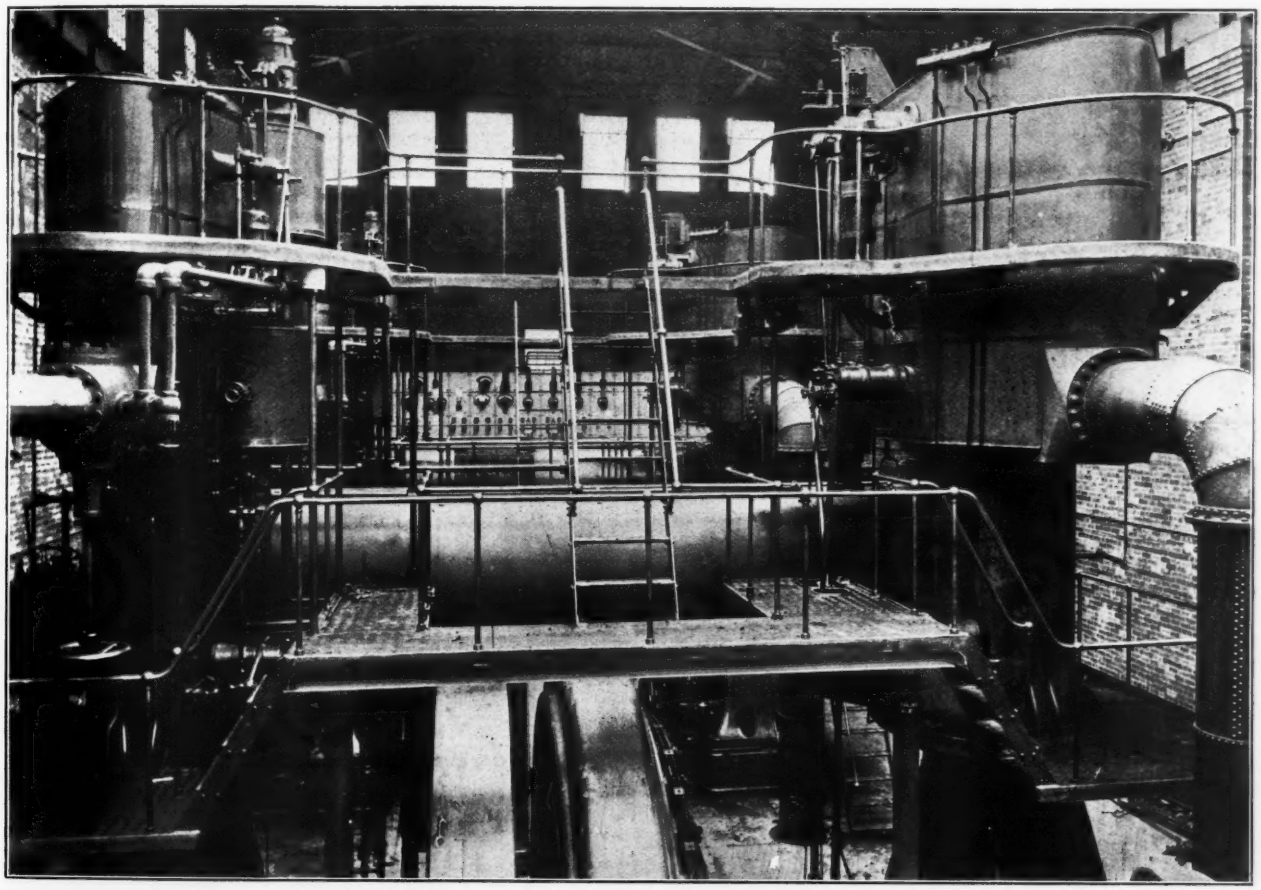
bility of flashing or heating. The seats in the trains are all arranged along the length of the carriages except in the trailer cars, where there is seating accommodation for sixteen passengers on cross seats in the centre. The trailer cars have at each end an automatic coupling lever, and a wheel for applying the hand brake, to be worked by the conductor should occasion arise. The trailer cars are fitted with the necessary electrical line to make a complete connection between the motor cars at each end. The coupling of the electrical line is extremely simple, being a seven-point plug and socket joint suitably protected by a light annealed cast-iron housing.

The cars are highly finished outside in dark red, relieved with gold lines. The first-class carriages have padded cane seats and are of polished mahogany, panel finish, inside, whereas the third-class carriages have bentwood cherry seats and a general finish of light oak.

The track is fitted throughout with insulated positive and return conductors. The former is on the outside of the track, the negative being between the running rails and lower than the other. The insulators, which are similar for both conductors, only differing in size, consist of a hollow block of vitrified earthenware on the top of which rests the flat base of the conductor rail, which is held securely in position by a pair of steel clips. The insulator block is carried on a broad-based foot, which has a vertical centre pin, over which the earthenware cube is cemented with molten sulphur, the base being secured to the cross sleepers of the track by coach screws. The insulators are situated at every third sleeper. The earthenware block of the positive rail insulator is six inches cube, the negative rail insulator six inches square by three inches deep. A wooden guard protects the positive rail from accidental contacts or earthing. The bonds are of the flexible type. The conductor rails are of two weights, *viz.*, 100 pounds per yard and sixty pounds per yard. They are in sixty-foot lengths.

The track rails are eighty-six pounds per yard in weight, and are laid on thirty-foot lengths, on cross sleepers, with thirteen to sixteen sleepers per rail length, instead of the usual eleven. The rails are of the bullhead section, and rest on wooden cushions recessed into chairs weighing fifty-four pounds each. The ballasting of the way consists of six inches of clinker ash at the surface, with four inches of broken sandstone below, resting upon a well packed floor of sandstone blocks. The sandstone used is part of that cut out in driving the tunnel.

The Electric Power Generating works are situated at Shore Road, adjoining the Hamilton square railway station, Birkenhead. The buildings are of brick and steel, substantially and neatly finished with stone trimmings. There are three new buildings in all—the power generating station proper (which is by far the largest and most substantial structure), the battery house and the fan house.



INTERIOR OF POWER-HOUSE, MERSEY RAILWAY, ENGLAND.

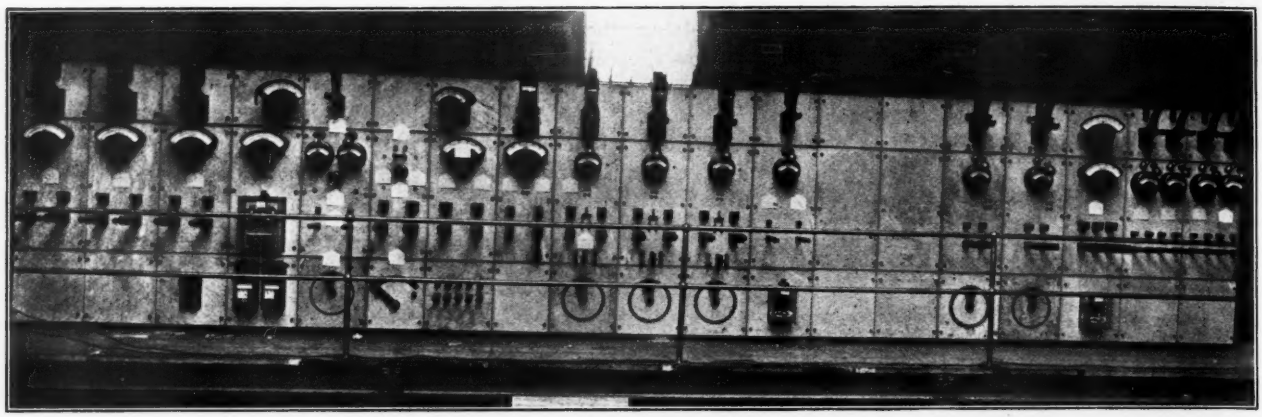
Alongside, on the same side, is the old pump house, connected with the tunnel drainage system. There is also a brick chimney of circular section, 250 feet high and of thirteen feet inside diameter. The power plant is all situated in the largest building, which has inside dimensions of 135 by 145 feet 9 inches. It is divided into two distinct parts by a brick wall; the boiler room occupies about seventy-nine feet of the building length and the engine room the rest.

The boiler room contains nine Stirling water-tube boilers, each having 4,370 square feet of heating surface, and work-

ing at a normal steam pressure of 170 pounds per square inch. Three of the boilers are arranged to work at low pressure for supplying steam to the pumping engines, which require the service of only one of the new boilers, although previously fed by four Lancashire boilers.

The feed water is drawn from the public supply, and after passing through the economizers enters the boilers at a temperature of about 212 degrees. The Holly gravity is in use. This is a simple arrangement of the drains and separators whereby great economy is secured; it is

gallons of condenser water per hour. Surface condensers of the Weir marine type are installed. Each boiler supplies direct into a steam header arranged on the ring system, composed of ten inch and twelve inch diameter steel piping. The exhaust main is of riveted sheet-steel



SWITCHBOARD, POWER-HOUSE, MERSEY RAILWAY, ENGLAND.

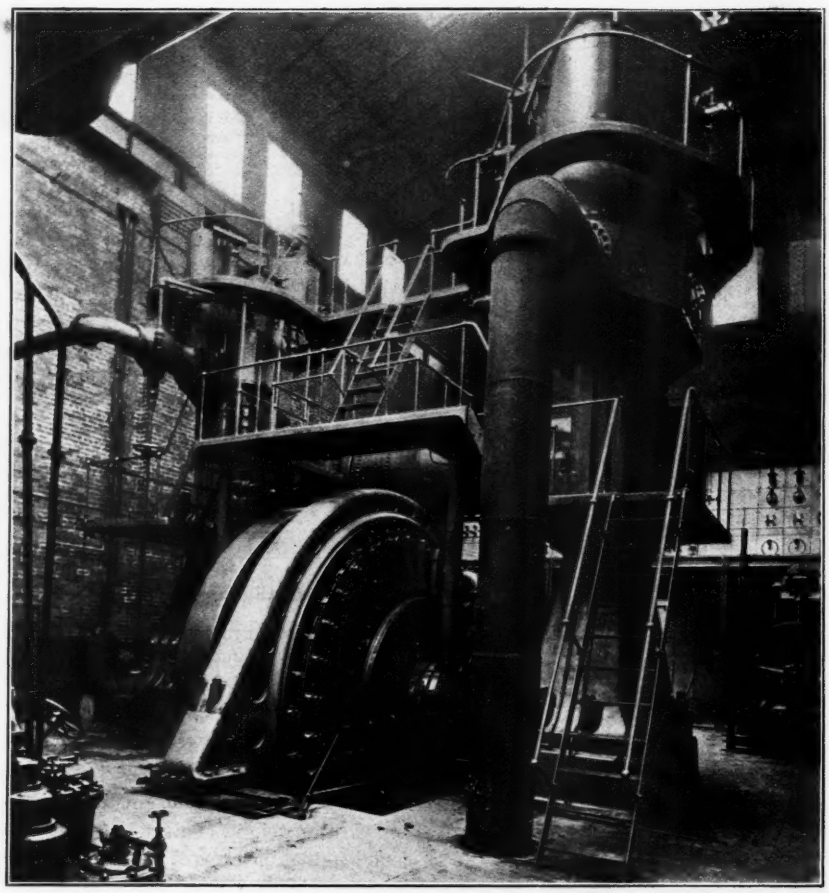
The boilers are fitted with Roney mechanical stokers, which receive their power from four Westinghouse standard steam engines of the four and one-half by four inch size. Economizers of the Clay-Cross type are used, the scrapers for these being operated by two Westinghouse electric motors of the direct-current multipolar type of five-horse-power capacity. The fuel used at present is Staffordshire coal, which is brought direct to the works by way of the docks railway, a branch of which encircles the generating station. The docks railway network is fed by all the railways of the country.

The coal is tipped direct into a breaker driven by a compound-wound direct-current Westinghouse electric motor of seven and one-half-horse-power capacity. The broken coal passes on to a bucket elevator, also driven by electric power, and is lifted up to the top floor of the boiler house, where it is distributed from a horizontal conveyor into a series of storage bins or hoppers, there being one hopper for each pair of boilers, or five in all, of which the total capacity is about 600 tons. The motor driving this combined elevator and conveyor is of the standard Westinghouse direct-current type of fifteen-horse-power capacity. From these coal stores the fuel feeds down by gravity through automatic weighing machines into the stokers. The ashes from the fires are conveyed from the pits to the railway wagons by the buckets of the coal elevator on their return journey. The conveyor driving gear is erected on a platform above the pumps and condensers, which occupy one end of the boiler house.

as yet little used in this country, but I believe it is very extensively adopted in America, where its advantages have been fully proved by years of practice. The Harris system of water softening is used. The plant installed has a capacity for softening 3,000 gallons of feed water per hour, and purifies from 8,000 to 10,000

pipe of diameters varying from thirty-two inches to forty-eight inches.

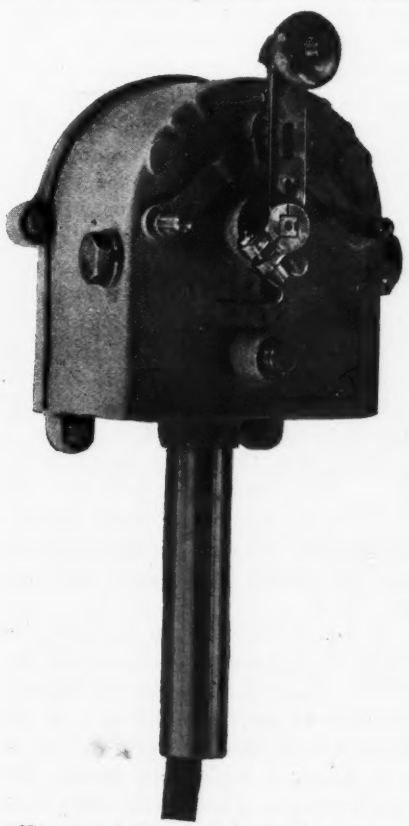
The engine and dynamo half of the power-house has two floors, on the upper of which the generating machinery is installed, while below the steam supply and exhaust piping systems are located.



ONE OF THE LARGE GENERATING SETS, MERSEY RAILWAY, ENGLAND.

The main electrical supply is generated

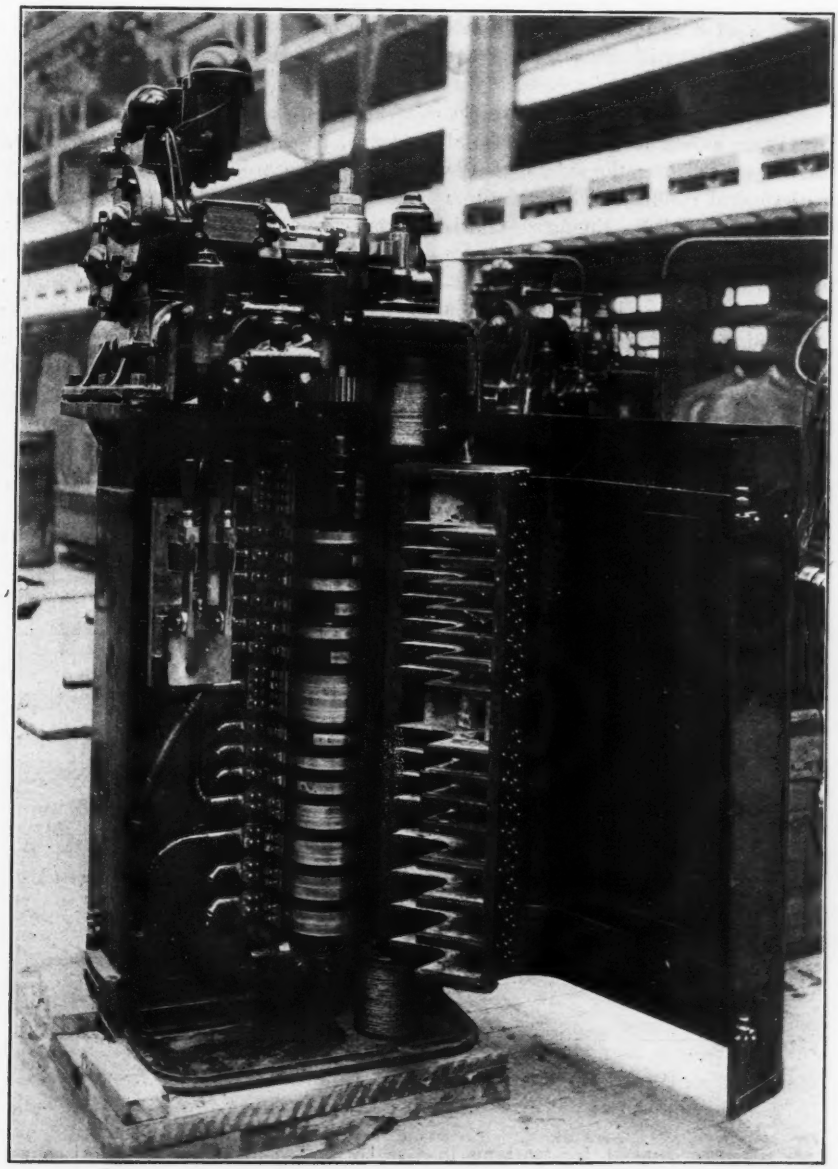
by three large sets, each consisting of a vertical compound steam engine direct-coupled to a Westinghouse double-current generator. The steam engines are of the Westinghouse Corliss type, with cylinders of thirty inches and sixty inches in diameter, and a stroke of forty-eight inches. The admission valves of the high-pressure cylinder are of the poppet type; the rest, both of the high and low-pressure sides, are simple Corliss valves. Reheating receivers are adopted on these engines. The normal full-load capacity of each engine is approximately 1,650 horse-power. Steam is supplied at a pressure of 170 pounds per square inch, the speed being ninety-four revolutions per minute. The floor space occupied by each set is some thirty square feet. The engines operate condensing with twenty-five-inch vacuum, and have an overload capacity of sixty per cent under those conditions, and forty per cent when running non-condensing. The generator of each set is built direct on the shaft between the high and low-pressure sides of the engine. Each machine has a rated capacity of 1,250 kilowatts generating direct current at a pressure of 650 volts,



MOTORMAN'S SWITCH, MERSEY RAILWAY, ENGLAND.

or three-phase alternating current of twenty-five cycles per second. As a matter of fact, no provision has been made for using any alternating current in connection with the Mersey railway at present. The whole of the route is supplied with the direct current as generated.

The generators are of the well-known standard Westinghouse multipolar type. The field consists of a vertically divided cast-steel ring, having thirty-two pole-pieces cast on its inner side projecting radially toward the centre. The pole-pieces are built up of soft steel stampings; losses due to eddy currents are thus reduced to a minimum, and a highly efficient magnetic circuit results. The fields are compound-wound, the shunt and series coils are wound separately, and every pole-piece bears a section of each winding. The field is over-compounded to give a rise of ten per cent in pressure of output, with change from no load to full rated load. The armature is of the slotted core drum-wound type, and is built exactly in accordance with the standard Westinghouse principles, having the core and the commutator built rigidly together on the one spider, which is pressed and keyed as one piece direct on to the engine shaft. The sheets of the core are stamped out in the form of segments, having inner lugs which dovetail into slots machined in the periphery of the cast-iron spider, the whole core being clamped solidly together by cast-steel end-rings. The armature windings are of copper bars forged together to final shape, and insulated before being fixed in the core slots. These large generators are built to cope continuously with overloads of fifty per cent without dangerous rise of temperature, and are designed to give their full rated output continuously



TYPE OF CONTROLLER, MERSEY RAILWAY, ENGLAND.

with a temperature rise not exceeding forty degrees above that of the external surroundings.

Two smaller generating sets, consisting of a Westinghouse compound engine of the 16 x 27 x 16 inch size and direct-coupled to a 200-kilowatt direct-current Westinghouse generator, are also installed. The engines are of the single-acting type, having a single horizontal piston valve fixed over the side by a side pair of vertical cylinders. The generators are of the standard Westinghouse multipolar, direct-current type, similar in construction to the large ones described, except that they are not provided with the extra armature connections and collecting rings for double-current working. The normal speed of these sets is 250 revolutions per minute. All the engines exhaust into a common main installed below the engine floor. The main is of sheet steel riveted, and is of reducing diameter, varying from forty-eight inches to thirty-two inches. The engine room also contains a motor-driven booster set for working in conjunction with a large storage battery.

The main switchboard of the power generating plant is installed on a gallery extending the full width of the engine room at one end, and raised about twelve feet above the floor level. The width of the gallery is about eighteen feet, which allows ample room both in front of and behind the switchboard. There are nineteen main panels on the board, all of the standard Westinghouse type, of marble, fitted with the usual forms of instruments, switches, etc. The work's lighting switchboards are separate and one is provided in each room. There are also many other auxiliary switchboards installed in various convenient parts of the works for the control of the small motors, etc. Incandescent electric lamps are used for lighting the power station, 210-volt lamps being used in series of sets of three. The battery house contains a set of 320 type "R" chloride accumulators.

There are nineteen main feeder cables passing from the power station to the various parts of the line, all of the lead-covered, paper-insulated type. From the main switchboard the cables are fixed to the solid rock of the tunnel, hanging on wrought-iron hook racks bolted to the rock-face.

In conclusion, thanks are due to the Mersey Railway Company, and to the British Westinghouse Company for the information and photographs contained in this article. A. W.

June 6.

Open Portion of Line, Mersey Railway, England.

The Massachusetts Institute of Technology.

The catalogue of the Massachusetts Institute of Technology, Boston, describes the scientific and technical courses offered at that institution. Thirteen distinct undergraduate courses are offered, covering the various branches of applied science. These extend over four years, and lead to the degree of bachelor of science. Graduate courses of one year are offered in mining engineering, metallurgy, architecture, chemistry, electrical engineering and naval architecture, these leading to the degree of master of science. During the summer vacation the institute offers systematic instruction in quite a considerable range of studies, including drawing, mathematics, general science and shop work, as well as languages. Professional summer schools, devoted mainly to field work, have been for a long time maintained by the institute.

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

THE HOME OFFICE ENQUIRY.

(Concluded.)

A large portion of the enquiry has centered round the possibility of working electrically driven coal-cutting machines. In fact the whole of the enquiry has narrowed itself to the two questions principally, the use of electric motors at the face of the coal, and the protection of the cables. Every mining engineer and every colliery manager who has been examined has been emphatic that the machine must be stopped immediately that gas is found where it is working, and that it must not be started again until the gas has been got rid of. It should perhaps be explained that what is known variously as marsh gas, fire-damp, etc., a gas very similar, but not exactly the same as the gas which is used for illuminating purposes, is formed in the coal in the process of the formation of the nature of the coal itself. Shallow seams usually have not much gas, by reason of the fact that the gas has a better chance of exuding through the strata above it, and so escaping to the upper atmosphere, and from the fact that less gas is formed in the shallower seams. The formation of the gas is a work of ages. The different constituents of which the coal is formed are gradually changed, with the pressure to which the seam is exposed, and with the chemical action which goes on, with the result that the longer the coal remains in the ground, that is to say, the deeper it lies, usually, the greater is the quantity of gas that is stored in it. The gas, which is that represented by the chemical symbols CH_4, not C_2H_4 which is the formula for illuminating gas is actually stored in the coal itself, under great pressure, and is believed to be in the liquid form. When the pressure is relieved by the removal of a certain quantity of coal from the face, the gas rushes out, and there is then danger until it has been got rid of.

One of the drawbacks to the use of electricity for lighting coal mines is the fact that the electric lamps do not show the presence of gas. The ordinary miner's lamp does. It has two distinct offices, to give light, and to show the presence of a dangerous gas. The miner's safety lamp, in its present form, consists of an oil-burning wick, with its oil-well, on top of which is a strong glass surrounding the flame, the glass itself being protected by wire bars, and above the glass two, three or more gauzes, protected by a metal bonnet,

really a metal shield, with a metal cap, and with ventilation holes between the metal cap and the bonnet. The air which supplies the oxygen to the flame is supplied from the bottom, through small gauze protected holes, and passes out at the holes at the top. When gas is present the flame of the lamp elongates, as skilful miners can tell by the appearance of the flame, which they make very small for the test, what percentage of gas is present. Gas is not explosive until it has been diluted by a certain percentage of atmospheric air. It will not ignite unless that percentage is present. It again becomes harmless when it has been diluted beyond a certain figure. In its first stage it can not ignite because there is not sufficient oxygen present. In its last stage it will not ignite because there is too much nitrogen present. Hence it is the rule that wherever a coal-cutting machine is working a safety lamp shall be also, and tests shall be made for gas periodically, when the machine is stopped to examine the roof.

Many experiments have been made with gas and enclosed motors, to ascertain how far they are dangerous, and several important matters have come out in this connection in the course of the enquiry. One witness stated that, in his opinion, there would be no danger from a sparking commutator, because with carbon brushes carbonic acid gas would be formed in such quantities as would kill any combustion. This witness also considered that an enclosed arc lamp would not be dangerous in an explosive mixture from the same cause. His idea was that if the motor was enclosed, and an outburst of gas took place, the gas would take some time to penetrate into the motor, and it would then have to encounter the CO_2, if there was any sparking, and if there was no sparking there would be no danger. Another witness gave particulars of an experiment in which he poured gas over an enclosed motor. It worked its way through to the commutator, ignited the gas inside and burnt the armature, but did not ignite the gas outside. This witness was impressed with the necessity of a flame-tight motor, and mentioned a special flame tight-joint which he had worked out. Another witness mentioned a somewhat similar experiment, in which he discharged ordinary coal gas over the commutator of a continuous-current machine, not enclosed, for a quarter of an hour, without ignition, though the brushes were rocked to and fro. Finally he did produce ignition by loading the machine up to double its normal load. Another witness described an experiment directly negativing the last described. He placed a small motor inside a box, into which gas was allowed to pass in inflammable proportions. When the brushes were cool, no ignition occurred, but as soon as they became heated ignition took place. This witness also described a case where the danger of cables is well illustrated. The cables in a particular mine were enclosed inside wood casing, which became damp. A small leakage current existed, and this slowly carbonized the wood and set fire to it, the prop on which the casing rested being also fired. Other witnesses described further experiments on the matter of the ignition of a gaseous mixture, but in these experiments the mixture employed was such as would fire in the ordinary way if sufficient heat was present.

Mr. W. E. Garforth, the managing director of a large colliery in Yorkshire, where electricity is largely employed, and who is also the managing director of one of the most successful coal-cutting machine companies, the Diamond, made a careful series of experiments with a gaseous mixture, consisting of ten per cent of ordinary town gas, and ninety per cent of ordinary atmospheric air. When this mixture was allowed to fill a special chamber in which motors of different construction were fixed, and an open continuous-current motor working with a pressure of 500 volts was allowed to run in the chamber, an explosion occurred in a few seconds. When an enclosed motor, running with the same pressure was fixed in a similar chamber no explosion took place, though the current was turned on and off repeatedly for several minutes. Further experiments were made to see if the gas would penetrate into the body of an enclosed motor, and would there cause an explosion. The result was that gas did filter through, and an explosion did take place inside the case, but it did not ignite the gas outside. This confirms the experiments that were made in Germany some few years since. Mr. Garforth also made some experiments with protectors of gauze, but apparently they were not satisfactory. Mr. William Mountain, of Messrs. Ernest Scott & Mountain, also made some experiments on somewhat similar lines, and he states that with mixtures of one part of gas to eight, ten and fifteen of air no explosion took place with an enclosed motor inside an air-tight box, into which the gaseous mixture was allowed to pass. The question of the mixture of gas and air, as mentioned above, alters the whole aspects of the experiment.

It would appear from the experiments with any one of the safety fuses fired that enclosed motors are fairly safe in explosive mixtures, but it would hardly be wise, in the writer's opinion, to rely on this, as workmen are apt to be very careless in these matters. In an electric coal-cutting machine, which the writer inspected a short time since, some one had put small pieces of coal between the brushes and the commutator, while the machine had been standing, presumably to see what would happen. In that case there was no gas present, but if a machine had been started in a gaseous mixture, under those conditions, an explosion might very easily have followed.

One of the most important parts of the enquiry related to the cables. In this country armored cables have been used almost universally for mining work, under the impression that the chances of explosion were lessened by their use, the idea being that the armor prevented the cable from being damaged by falls, etc. In one case in particular it was stated that a fall occurred and the armor was forced through the insulation to the conductor, and a man was killed subsequently by accidentally taking hold of the cable with one hand and placing his shoulder against an iron coal tub (wagon), which was in connection with the other side of the circuit. One eminent firm in Scotland has consistently advocated the use of concentric armored cable, the outer conductor being formed by the armor itself, and uninsulated. It is a commentary on this that one of the deaths which have occurred in coal mines from electricity was directly traceable to this practice, though it is only fair to say that considerable modification had been introduced in the arrangement. In the case in question, at Exhall colliery, in Warwickshire, the service was at 500 volts and concentric cables, with the outer uninsulated, were used, but at a certain distance from the pit bottom the concentric cable had been abandoned and a single cable used, the return current being taken by a water pipe connected to the pump, which was being worked by the motor supplied by the single cable. When men went to widen the road leading to the pump, an iron girder, which was allowed to fall, skinned the conductor, making contact with it, and when one of the men caught hold of the girder he got a shock which killed him. The men in this case were working in water several inches deep. The argument of the firm which advocates concentric cables with uninsulated outer is, that it will be im-

possible to get a shock, because it will be impossible for any one to grasp the inner conductor. The above case shows the fallacy of this argument, and although it may be argued that the accident occurred in consequence of the concentric form having been abandoned, this really only illustrates what may very easily happen in one way or another. The method would be perfect if you could make sure that the inner conductor would never come to the outside, but you can not be sure of that. At switches, fuse boxes, brushes and at other places the inner conductor comes within reach and may be grasped, and then there is no possibility of escape, as the whole of the mine forms part of the return path for the current. Coal itself is a very poor conductor, but like water, where there is a sufficiently good conductor to be troublesome. The general consensus of opinion among the electrical witnesses was that earth—"ground," as you call it more sensibly in America—should be kept out of the service altogether. An exception to this opinion is the case of the Scotch firm which so strongly advocates the concentric with uninsulated outer. Another argument that is used by the firm in question, in support of its contention, is that if connection does take place between the inner and the outer, the fuse will blow, and the pressure will be off the service. This again has been shown to be a fallacy, in the course of the enquiry. It has come out repeatedly in the evidence that in mining work fuses are utterly unreliable. As electrical engineers well know, fuses at their best are subject to considerable influences, such as the temperature of the surrounding atmosphere, the time the fuse itself has been in its place, the nature of the current, whether it rises above the normal very much and very frequently, and others of a like nature. But the fuse in a central station, or in any position where there are men who understand the matter constantly at hand to see to things, is reliability itself, with all its imperfections, compared to the fuse in a coal mine, or, for the matter of that, in any industrial work, where the fuses are in charge of the ordinary mechanic or the engine room attendant. What usually happens is, when the fuse is first put in its place, it is of the proper strength, or possibly a little below, as the engineer may want to be sure of his circuits. Then the service is cut off suddenly, when something important is on hand, and a new fuse is put in. This goes in the same manner. Then a larger fuse is put in, and this goes after a little longer time, so a still larger fuse is put in, and so it goes on till the fuse is really able to carry as much current as the conductor of the cable itself. Many witnesses condemned the use of fuses entirely except at the generating station and at the pit bottom. One witness mentioned a case where a fire had been caused by a fuse "blowing" inside a wooden box. The enquiry brought out the fact that all fuses and switches are now enclosed in iron cases which are made as gas-tight as is possible, and it was suggested that the keys of the fuse and switch boxes should be in the hands of a responsible man who should only open them when the current had previously been switched off on the generator side, say, at the pit bottom or at the main switchboard. This is also a most important point. Some of the accidents which take place in connection with electricity are due to the pressure being on the cables when repairs are being done. If attention is given to this point, there will probably be fewer accidents.

As was to be expected, the question of continuous-current *vs.* polyphase currents came up at the enquiry, and the opinion seemed to be that polyphase motors were safer than continuous-current. Mr. Garforth, who is the managing director of the Diamond Coal-Cutting Machine Company, has adopted polyphase motors to his coal-cutting machines, and they are doing well. One of the objections to polyphase machines is the matter of the starting torque, but this is easily got over in various ways.

The matter of firing shots by electricity has also come up at the enquiry, and the mining witnesses who dealt with this principally were unanimous in the opinion that firing by electricity should not be made compulsory. One mining witness was of the opinion that the old "squib," as it is called, was quite as safe as the electric fuse if properly watched. The old mining "squib" consists of a straw filled with powder and inserted into the charge, the outer end being lighted. Several instances were given of shots missing fire and causing accidents afterward, owing to the shot firers going to the shot and its afterwards going off, and this would appear to largely discount the hitherto supposed value of the electrical method. It has been supposed that when firing by electricity, if the shot did not go off when the current was turned on, the shot firer might go to it immediately after, instead of waiting for the fuse to burn itself out, as would be necessary with powder. The fault seems to be in the fuse itself, which has been long known to be very uncertain. There are two kinds of fuses employed in shot firing in mines. In one there is a very short length of very fine platinum wire, bridged across the two leads connected with the firing battery, and the fine wire is made to glow at a dull red when a current is passed through it. In the other form, two copper wires are embedded in a tube of gutta-percha, similar to the coating of a gutta-percha covered wire, the ends of the wires protruding outside the tube, a very short distance. When the wires are connected to the firing battery, and a current is sent through, a spark passes across the gap between the wires. In both forms, the wire and the ends of the copper wires are embedded in a detonating substance, such as fulminate of mercury, which ignites when heat is presented to it, either by the heated platinum wire or by the spark, and fires the charge of powder or other explosives. There are several possible causes of failure in both systems. With the fine platinum wire, the wire itself is liable to be ruptured, breaking the circuit, and it is liable to be ruptured in the act of firing, in such a way as not to fire the charge, because the heat is not present for a sufficiently long time. The time required is very short, but a certain definite time is required, and it may happen that the wire does not maintain its continuity long enough for this minimum time. With the high-tension fuse, as it is usually termed, the fuse in which firing is done by means of the spark which passes across the gap between two wires, there is a considerable element of uncertainty in the gap itself. One fuse will fire with a pressure of two volts and the next will not fire under perhaps 100 volts. As it is difficult to construct light magneto firing machines for much over fifty volts, this led to a considerable amount of trouble in days gone by.

The manufacture of fuses has been considerably improved during recent years, and also the manufacture of small magnetos for firing, so that the trouble is not what it was from that cause, but it occasionally comes up even now. Then there is another trouble which is common to all fuses which are fired by heat delivered to a detonating substance. The detonating substance may be good or bad. That is to say, it may fire immediately the necessary quantity of heat is delivered to it, and it may not, because it has been constructed of materials which will not act so quickly. Further, if the detonator has been made of proper materials, it may have been kept in a damp place, and will then not fire.

PRACTICAL TELEPHONE ENGINEERING.

(Continued from page 886)

As in the first example it is necessary to ascertain how many exchanges should be provided. We first draw a horizontal line *g g*, dividing the number of subscribers equally, 2,950 above and 2,950 below the line; we then draw a vertical line *h h*, dividing the subscribers equally on either side, giving the exchange location for a plant with only one exchange at *i*. This exchange should be provided with an immediate capacity of not less than 6,480, with an ultimate capacity of say 10,000. The cost of this plant we will assume amounts to approximately $1,000,000.

In order to determine if more than one exchange would be best, we divide the city first into two districts, located east and west of the line *h h*, each district containing 2,950 subscribers, and in the same way as the exchange at *i* was located, we find the exchange locations *j* and *k* for the eastern and western districts. Each of these should be provided with exchanges having an immediate capacity of, say, 3,360 and ultimate of 5,040, and the cost of the plant we will assume would be $850,000. By dividing the city into districts, as shown by the dotted lines, and working out the exchange location for each district by drawing horizontal lines and vertical lines in the same way as the locations for one and two exchanges were selected, we get the points *l m* and *n* as the exchange locations for the districts west of line *a b*, north of the line *b c*, and the district bounded by the lines *a b*, *b c* and *c d*, respectively. It seems at first as if a separate exchange should be provided for the district east of the line *c d*; but the saving in cable we will assume is not sufficient to justify the expense of this fourth exchange, and it is therefore best to connect these 350 subscribers direct to the main exchange located at the point *n*. For the 3,300 subscribers included in the district bounded by the lines *a b*, *b c* and *c d* and the 350 subscribers east of the line *c d* an exchange should be provided having an immediate capacity of say 3,840 and ultimate of 6,000. For the district included within the lines *b e*, *b c* and *f c*, the exchange capacity should be about 1,920 immediate and 2,880 ultimate, and for the district west of the line *a b* the exchange capacity should be about 720 immediate and 1,120 ultimate. The cost of the plant with these three exchanges we will assume would be about $750,000, and therefore would be the most economical design.

For the third example we will assume a city of about 1,500,000 population, covering a territory as shown in Fig. 3. The exchange locations to be selected finally for this plant are shown at the points *a*, *b*, *c*, *d*, *e*, *f*, *g*. In deciding on this number of exchanges, as in the two previous examples, careful consideration we will assume was first paid to the advisability of establishing a fewer number of exchanges of larger capacities than those selected, both from a standpoint of first cost of plant as well as practicability of operation.

The districts to be supplied from the respective exchanges are shown enclosed by dotted lines and marked H, I, J, K, L, M and N. The approximate number of subscribers located in these districts being 3,500, 3,000, 1,500, 1,500, 700, 1,000 and 150. The exchange equipments for these districts should be selected about as follows: For exchange *a* the immediate capacity of board should be about 4,320 lines, with an ultimate capacity of 6,000; exchange *b* should have an immediate capacity of about 3,840 and ultimate 6,000; exchange *c* an immediate capacity of about 1,920 and ultimate 2,400; exchange *d* an immediate capacity of about 1,920 and ultimate 2,400; exchange *e* an immediate capacity of about 960 and ultimate 1,680; exchange *f* an immediate capacity of about 1,200 and ultimate 1,680; and exchange *g* an immediate capacity of about 240 and ultimate 480, making a total capacity of 14,400 lines, and total ultimate capacity of 20,640 for a total actual number of subscribers amounting in all to 11,350. Modern telephone practice tends toward the installation of very large boards, and in many cases to the installation of two large boards in one exchange building, the boards being connected together by trunking cables. However, in this and the two previous examples only one board to an exchange has been considered, as the space will not permit of the discussion of the advisability of installing two boards. Single boards of as large an ultimate capacity as 12,000 lines have been installed or at least put on exhibition, but it is questionable if these boards are free from troubles of cross-talk, etc., as it requires a considerable reduction of the insulating surface between the jacks. Furthermore, it is hardly possible for an operator on one of these large boards to reach all the subscribers even with the aid of the adjacent operator, on account of the extreme height of the board. For these reasons it is often advisable not to install boards of more than an ultimate capacity of 6,000 lines, as in these examples.

In estimating on the cost of telephone plants it is a good plan to subdivide the cost under the following headings, and then estimate separately on these.

1. Subway, estimated lineal feet of trench work or duct feet of conduit.
2. Cleaning and wiring conduits.
3. Lateral connections from subway to poles and houses.
4. Pole lines.
5. Distributing poles.
6. Underground cables, including trunking cables between exchanges.
7. Aerial cables, including trunking cables.
8. Subscribers wiring from cable terminals to telephone instruments.
9. Exchange equipments.
10. Telephone instruments.
11. Buildings and lands.
12. Engineering expenses.
13. Contingencies.

Annual Meeting of the New York Electrical Society.

The annual meeting of the New York Electrical Society was held at the Café Boulevard, June 10. The officers elected for the season 1903-1904 were: President, J. J. Carty; vice-presidents, W. I. Donshea, Hobart D. Betts, W. S. Barstow, Douglass Burnett, H. C. Townsend, F. C. Bates; secretary, George H. Guy; treasurer, Henry A. Sinclair.

The membership of the society is now 619, as against 513 last year. There were twenty-six resignations and three deaths during the year, and fifty-one were struck off the list, leaving a net gain of 106. The society has never been so sound in finances, solid in the quality of its membership, and effective in its work as it now is, and the character of the meetings which it has given under the able presidency of Dr. Sheldon is one of which any organization could be proud.

Seventy of the members and their friends sat down to an excellent dinner and enjoyed a good musical programme which followed. Mr. Charles Stuart Phillips was a conspicuous performer.

The New Canadian Westinghouse Company.

The Canadian Westinghouse Company, capitalized at $2,500,000, is about to be established in Canada, on a site to be selected in one of the manufacturing towns of the province of Ontario. The output of the many Westinghouse industries in the United States is some $50,000,000 per year in actual shipments. Of this output, electrical apparatus to the value of $1,500,000 to $2,000,000 annually is sent into the Dominion of Canada. For some years past the Westinghouse Companies have had an air brake works at Hamilton, Ontario. It is now proposed to amalgamate the Canadian air brake business with that of the new Canadian Westinghouse Electric Company. It is not yet decided whether the new company will settle at Hamilton or elsewhere. The formation of a new company, however, is certain.

Electrical Transmission under Land and Water.

By Alton D. Adams.

ENERGY transmitted over long distances must sometimes pass through conductors that are underground or beneath water. In some other cases it is a question of relative advantages merely, whether portions of a transmission line go under water or overhead. Where the transmitted energy must enter a substation in the heart of a large city it not infrequently must go by the way of underground conductors without regard to the voltage employed. In some cities the transmission lines may be carried overhead, provided that their voltage is within some moderate figure, but not otherwise. Here it becomes a question whether transmission lines at high voltage shall be carried underground, or whether transforming stations shall be established outside of the restricted area and then low-pressure lines brought into the business section overhead or underground, as desired. Where a transmission line must cross a steam railway track it may be required to be underground, whether the voltage is reduced or not. The distance across a body of water in the path of a transmission line may be so great that a span is impossible and a cable under the water therefore necessary. Such a cable may work at the regular line voltage, or a transformer station may be established on one side or on each side of the body of water. Even where it is possible to span a body of water with a transmission line, the cost of the span and of its supports may be so great that a submarine cable is more desirable. A moderate increase in the length of a transmission line in order to avoid the use of a submarine cable is almost always advisable, but where rivers are in the path of the line it is generally impossible to avoid crossing them either overhead or underneath. Thus, St. Paul could only be reached with the 25,000-volt line from the falls on Apple River by crossing the St. Croix River, one-half mile wide, on the way. In order to carry out the 40,000-volt transmission between Colgate and Oakland, the Carquinez Straits which intervened with nearly a mile of clear water were crossed. Sometimes, as in the former of the two cases just named, an existing bridge may be utilized to support a transmission line, but more frequently the choice lies between an overhead span from bank to bank of a river and a submarine cable between the same points.

The prime advantage of an overhead line at high voltage is its comparatively small first cost which is only a fraction of that of an underground or submarine cable in the great majority of instances. At very high voltages, like 40,000 to 50,000 or more, the overhead line must also be given first place on the score of reliability, since the lasting quality of underground and submarine cables at such pressures is as yet an unknown quantity. On the other hand, at voltages in which cable insulation has been shown by experience to be thoroughly effective, underground or submarine cables may be more reliable than overhead lines because of the greater freedom from mechanical disturbances which these cables enjoy.

In the business portions of many cities a transmission line must go underground, whether its voltage is high or low. Under these conditions it may be desired either to transmit energy to a substation for distribution within the area where conductors must be underground, or to transmit energy from a generating station there located to outside points. If the transmitted energy is reduced in pressure before reaching such a substation, a transforming station must be provided, and this will allow the underground cables to operate at a moderate voltage. For such a case the advantages as to insulation at the lower voltage should be compared with the additional weight of conductors in the cable and the cost of the transforming apparatus. If the voltage at which current is delivered at the transforming station does not correspond with the required voltage of distribution at the substation, the necessary equipment of step-down transformers is doubled in capacity by lowering the voltage of the transmitted energy where it passes from the overhead line to the underground cables. Conditions of just this sort exist at Buffalo in connection with the delivery of energy from the power stations at Niagara Falls. This transmission was at first carried out at 11,000 volts, and a terminal station was located at the Buffalo city limits where the overhead lines joined underground cables that continued the transmission at the same voltage to several substations in different parts of the city. Later the voltage of the overhead transmission line was raised to 22,000, and it not being thought advisable to subject the insulation of the underground cables to this higher pressure transformers were installed at the terminal station to lower the line voltage to 11,000 for the underground cables. As the substations in this case also have transformers, there are two kilowatts of capacity in step-down transformers for each kilowatt of delivery capacity at the substations.

The saving effected in capacity of transformers and in the weight of cables by continuing the full transmission voltage right up to the substations whence distribution takes place, furnishes a strong motive to work underground cables at the pressure of the overhead transmission line of which they form the continuation. Thus, at Hartford the 10,000-volt overhead lines that bring energy from water power stations to the outskirts of the city connect directly in terminal houses there with underground cables that complete the transmission to the substation at the full line voltage. In Springfield, Mass., the overhead transmission lines from water power stations connect directly with underground cables at a distance of nearly two miles from the substation, and these cables are thus subject to the full line pressure of 6,000 volts. The overhead line that brings energy at 25,000 volts from Apple River falls to St. Paul terminates about three miles from the substation there, and the transmission is completed by underground cables that carry current at the 25,000-volt pressure.

In these and similar cases the relative advantages of underground cables at the full voltage of transmission and of overhead lines at a much lower pressure, in the central portions of cities, must be compared. The overhead lines at moderate voltage will no doubt cost less in almost every case than underground cables of equal length and at the full transmission voltage.

As an offset to the lower cost of overhead city lines at moderate voltage, where they are permitted by local regulations, comes the increase in weight of conductors due to the low pressure on the overhead lines, and also the cost of additional transformer capacity, unless the lines that complete the transmission operate at the voltage of distribution. The 10,000-volt lines that transmit energy from Great Falls to Portland, Me., terminate in two transformer houses that are distant about 0.5 mile and 2.5 miles, respectively, from the substation there. In these transformer houses the voltage is reduced to 2,500, and the transmission is then continued at this pressure to the substation

whence distribution takes place without further transformation.

Where a river or other body of water must be crossed by a transmission line, either of three plans may be followed. The overhead line may be continued as such across the water, either by a single span or by two or more spans supported by one or more piers built for that purpose in the water. The overhead line may connect directly with a submarine cable, this cable being thus exposed to the full voltage of the transmission. As a third expedient, a submarine cable may be laid and connected with step-down transformers on one bank and with step-up transformers on the other bank of the river or other body of water to be crossed. The overhead lines connecting with these transformers can obviously be operated at any desired voltage, and this is also true of the cable.

Even though the distance across a body of water is not so great that a transmission line can not be carried over it in a single span, the cost of such a span may be very large. A case in point is that of the Colgate and Oakland line where it crosses the Carquinez Straits by a span of 4,427 feet. These straits are about 3,200 feet wide where the transmission line crosses, and overhead lines were required to be not less than 200 feet above high water so as not to impede navigation. In order to gain in ground elevation and thus reduce the necessary height of towers, two points 4,427 feet apart on opposite sides of the straits were selected for their location. Under these circumstances two steel towers, one sixty-five feet and the other 225 feet high, were required to support the four steel cables that act as conductors across the straits. To take the strain of these four cables, each with a clear span nearly three times as great as that of the Brooklyn Bridge, eight anchors with housed strain insulators were constructed, four on the land side of each tower. On each of these anchors the strain is said to be 24,000 pounds. At each end of the cables making this span is a switch-house where either of the two three-phase transmission lines may be connected to any three of the four steel cables, thus leaving one cable free for repairs. It is not possible to state here the relative cost of these steel towers and cables in comparison with that of submarine cables for the same work, but at first glance the question appears to be an open one. The voltage of 40,000, at which this transmission is carried out, is probably higher than that on any submarine cable in use, but there seems to be no good reason why a suitable cable can not be operated at this voltage. Whatever the limitations of voltage as applied to submarine cables, it would, of course, have been practicable to use step-up and step-down transformers at the switch-houses and thus operate a submarine cable at any voltage desired.

In another case, on a transmission between Portsmouth and Dover, N. H., it was necessary to cross an arm of the sea on a line 4,811 feet long with a three-phase circuit operating at 13,500 volts. It was decided to avoid the use of either a great span or of raising and lowering transformers at this crossing, and to complete the line through a submarine cable operating at the full voltage of transmission. To this end a brick terminal house six by eight feet inside and with an elevation of thirteen feet from the concrete floor to the tile roof, was erected on each bank of the bay at the point where the submarine cable came out of the water. The lead-covered cable pierced the foundation of each of these terminal houses at a point four feet below the floor level and rose thence on one wall to an elevation eleven feet above the floor to a point where connection was made with the ends of the overhead lines. From this connection on each of the three conductors a tap was carried to a switch and series of lightning arresters. A single lead-covered cable containing three conductors makes connection between these two terminal houses. At each end of this cable the lead sheath joins a terminal bell one foot long and 2.5 inches in outside diameter, increasing to four inches at the end where the three conductors pass out. This terminal bell is filled nearly to the flaring upper end with an insulating compound.

In the instance just named it seems probable that the cost of the submarine cable was less than would have been the outlay for shore supports and a span nearly a mile long across this body of water.

Underground and submarine cables have been operated at voltages suitable for transmission during periods sufficiently long to demonstrate their general reliability. The Ferranti underground cables between Deptford and London have regularly carried current at 11,000 volts since a date prior to 1890. During about five years cables with an aggregate length of sixteen miles have transmitted power from St. Anthony's Falls to Minneapolis. At Buffalo, some thirty miles of rubber-insulated cables have been in use for underground work at 11,000 volts since 1897, and eighteen miles of paper-insulated cable since the first part of 1901. These examples are enough to show that transmission through underground cables at 11,000 to 12,000 volts is entirely practicable. At Reading, Pa., an underground cable one mile long has carried three-phase current at 16,000 volts for the Oley Valley Railway since some time in 1902. The cables in the transmission from Apple River to St. Paul, which carry three-phase current at 25,000 volts, have a total length of three miles and have been in use since 1900. This voltage of 25,000 is probably the highest in regular use on any underground or submarine cable conveying energy for light or power. From the experience thus far gained there is much reason to think that voltages thus far applied to underground cables may be very materially increased before a prohibitive cost of insulation is reached.

On submarine cables the voltage of 13,500 in the Portsmouth and Dover transmission, above mentioned, is perhaps as great as any in use. It does not appear, however, that any material difference exists, as to the strain on its insulation at a given voltage, between a cable when laid in an underground conduit and when laid under water. In either case the entire stress of the voltage employed operates on the insulation between the several conductors in the cable, and between each conductor and the metallic sheath. Underground conduits have little or no value as insulators of high voltages, because it is practically impossible to keep them watertight and prevent absorption or condensation of moisture therein. For these reasons a cable that gives good results at 25,000 volts in an underground conduit should be available for use at an equal voltage under water. The standard structure of high-voltage cables for either underground or submarine work includes a continuous metallic sheath outside of each conductor or of each group of conductors that goes to make up a circuit. As most transmissions are now carried out with three-phase current, the three conductors corresponding to a three-phase circuit are usually contained in a single cable and covered by a single sheath. The cables used in transmission systems at Portsmouth, Buffalo and St. Paul are of this type. If single-phase or two-phase current is transmitted, each cable should contain the two conductors that go to make up a circuit. In work with alternating currents the use of only one conductor per cable should be avoided because of the loss of energy that results from the currents induced in the metallic sheath of such a cable.

(To be continued.)

Canadian Electrical Association.

Proceedings and Papers at the Thirteenth Annual Convention, Held in Toronto, Canada, June 10, 11, 12.

THE thirteenth annual convention of the Canadian Electrical Association opened on Wednesday, June 10, at 11 A. M., in the Assembly Hall of the King Edward Hotel, in the city of Toronto, and continued in session until Friday at 1 P. M.

A large number of members and visitors were in attendance, among whom were noticed the following: Robert T. Lozier, Cincinnati; G. U. G. Holman, Levis County; Charles Henry Hims, Montreal; Charles F. Scott, Pittsburg, Pa.; F. H. Leonard, Jr., Montreal; Dr. R. B. Owens, Montreal; A. P. Manning, New York; P. H. Hover, New York; L. Denis, Quebec; F. Simmons, Kingston; G. A. Paterson, Brandon; Frank G. Bolles, Cincinnati; R. J. Russell, St. Louis; J. W. Pitcher, Halifax; C. H. Abbott, St. John, New Brunswick; Fred Thomson, Montreal; H. B. Kirkland, Chelsea, Mass.; J. Frederic Thorne, Pittsburg, Pa.; C. C. Starr, Halifax; Ormand Higman, Ottawa; P. G Gossler, Montreal.

The president, Mr. B. F. Reesor, manager of the Electric Light and Power Company, of Lindsay, occupied the chair. In the absence of Mayor Urquart, a welcome on behalf of the city was extended by Alderman Starr and Alderman Ward, to which Mr. A. A. Dion, of Ottawa, replied.

In his annual address the president congratulated the members upon the favorable circumstances under which they were meeting. He pointed out that during the year the question of long-distance power transmission had engrossed the minds of capitalists to a greater degree perhaps than at any previous period in the history of the country. Rapid strides had been made in development in this direction, and at the present time some very extensive plants were contemplated or under construction, notably around the Niagara peninsula, and when completed Canada could boast of having some of the largest and best equipped electrical installations in the world.

Mr. Reesor asked the members not to lose sight of the fact that the tide of municipal ownership was in full flow, and they learned of individuals and municipal councils with whom it had become considerable of a craze, or, in other words, a case of "municipalities gone mad." During all this turmoil of unrest they must not forget that vested interests were at stake and must be looked after. Millions of money had been invested in this country by individuals and companies in lighting and power development, sanctioned, and in many instances induced by the very municipal corporations that were now clamoring after or looking with longing and covetous eyes at a business that had been carried from an experimental stage until it had become to all appearances a factor of considerable importance to everyday commercial life.

Upon the business being taken up, the report of the secretary-treasurer, Mr. C. H. Mortimer, was read, showing a present membership of 375. The receipts for the year were $1,398.11, and there was a balance on hand of $404.17. This was exclusive of a donation of $500 made by the Canadian General Electric Company.

A letter was read from the Mayor of St. Louis inviting the association to hold its convention next year at St. Louis. The Business Men's League, of St. Louis, invited the association to that city. Professor Owens, of Montreal, explained to the members that there would be an international electrical convention during the first week of September, 1904.

Reference was made to the Conmee Act in the report of the Legislation Committee, which was presented by Mr. John Yule, manager of the Guelph Light and Power Company. The report stated that it might be assumed that the underlying principles of the Conmee bill are considered and admitted to be a reasonable protection to those who were induced to invest capital in and have developed the lighting business to its present proportions. The future danger was that amendments to the act would be made unless carefully watched. These amendments might very seriously affect the values of the members' properties. The amendment most discussed in the legislature was a clause that would give municipalities the right to compel sale or to expropriate. The committee considered it advisable to discuss whether or not the Canadian Electrical Association should continue to assume the responsibility of looking after the interests of the companies. The financial support accorded the Legislation Committee by the companies fell short of what it ought to be. In a vigorous attack, such as was made on the companies a few weeks ago, there was no time to stop and consider the financial situation, and the result was that the committee was considerably short of funds. Those who were receiving the benefits should place sufficient funds in the hands of the committee to pay all liabilities.

This report was not discussed by the meeting, but was handed over to the executive committee to deal with.

A paper on "The Training of the High-Tension Engineer," which had been prepared by Mr. Paul Lincoln, of Pittsburg, was read by Mr. Charles F. Scott, of Pittsburg, Pa., on Wednesday afternoon. In this paper the writer, in part, said:

There are two schools in which the electrical engineer may receive his training, but only one in which he must receive a course before he can be called a high-tension engineer. Those things which are learned in the schools, equipped with professors and laboratories and mathematical text-books, must be supplemented by the things which can be "learned only in the school of 'experience.'" These two schools are quite different in method. The college instructs in theory and in those methods of doing things which have become a standard by universal adoption. The college teaches positive knowledge. In the school of experience, on the other hand, one is more apt to learn how not to do it, and by the elimination of the unsuccessful arrive at the goal of success. The knowledge gained by experience is more often negative.

The college graduate enters practical work invariably feeling that the greatest danger of his work lies in his liability of receiving a shock from the high-tension conductors. Not until he has experience with accidents of an electrical nature does he learn that it is the danger of being burned that he has to fear more than the danger of shock.

This paper was supplemented by Mr. Scott and much valuable information imparted. In the discussion which followed, Professor Owens, of McGill University, Montreal, spoke with reference to the college side of the question, and Mr. R. G. Black, of the Toronto Electric Light Company, dealt with it from the standpoint of the operator.

In a paper by Mr. R. T. Lozier, of Cincinnati, Ohio, on "Variable Speed Motors and Their Relation to New Shop Methods," the following points were emphasized:

The speed of the individual motor could not have been fully controlled successfully if it were not for the multi-voltage system, which would never have had

its application if it were not for the development of the individual motor, and the new shop methods could never have reached their present development if it were not for the individual motor properly controlled. In fact, the shop methods would never have gone beyond the highly developed theory of the academician. He was not losing sight of the possibility of using a mechanical means of varying the tool speed while it works, but these devices have not been developed as yet.

What these three factors now joined together are able to accomplish is this: Working every machine tool in a shop at its highest output, thereby making it possible to increase the output of the average shop operating under the old conditions by 300 to 400 per cent.

Mr. Lozier said the speed range having been determined the next step was to select the methods to be used in obtaining the results required, and these were three, namely, mechanical, electrical and the combination of electrical and mechanical.

He said that Mr. William Cooper, on the subject of "methods of speed control," had stated the following interesting deductions:

(1) The total range of speed using both variable voltage and field regulation will be as the square of the range of voltages.

(2) Change of horse-power will be directly proportional to change of voltage on armature, field being constant.

(3) Change of horse-power by change of field strength will be inversely proportional to change in speed, voltage on armature remaining constant.

(4) The relative size of motor as referred to the maximum speed will be directly proportional to its speed variation when using variable voltages.

(5) The relative size of motor as referred to maximum speed will be as the square of the speed variation when using field regulation.

In discussing the advantages of the individually applied motor, Mr. Lozier stated that it went a long way toward enabling the new shop method to place in the hands of the employer a means of discounting the demand of the labor union for shorter time and higher wages, which means consisted of working his men and his tools at a far higher rate of efficiency, the ultimate result of which was a much greater output, despite the increase in the pay-roll and the shortening of the hours worked.

In discussing this paper, Mr. Leonard, of Montreal, said that in Canada with the conditions existing, where almost all the plants were operated on the alternating-current system, it was rather difficult to obtain the direct current for variable speed purposes unless some means of conversion were provided; under such conditions he thought for shop operation a system employing alternating-current induction motors for all constant-speed work was the ideal system.

A paper on "Some Points Relating to Submarine Electric Power Cables" was presented by Mr. Holman, of Quebec, dealing with a submarine power cable belonging to the Canadian Electric Light Company, which supplies 1,000 horse-power to the Quebec Railway, Light and Power Company in the city of Quebec, laid on the bed of the St. Lawrence River, the terminal cable bells of which were approximately 3,400 feet apart. In connection with this cable the weak point was early shown to be the pressure wires. A breakdown had occurred and upon a minute examination of the break it was evident that a ground between the armor and one of the power conductors so weakened the insulation by virtue of the heating at that point of the rubber insulation that a short-circuit ensued between the two neighboring conductors. The cable had been repaired and had been in successful operation since that time.

Mr. R. J. Russell, of St. Louis, Mo., read a paper on "Single-Phase Motors as a Means of Increasing Station Earnings," in which he advocated the following arrangement of station service:

(*a*) For large plants. Polyphase generators, with switchboard arranged for operating.

(1) Polyphase feeders for all large power and rotary converter service.

(2) Single-phase feeders for all general lighting service and for all small power work, the switchboard facilities being such that any single-phase feeder may be switched to either phase of the generator busses.

(3) Independent feeder regulators for all polyphase as well as single-phase feeders.

(*b*) For small stations. Either polyphase generator with single-phase feeders, which may be thrown by the proper switchboard devices to either phase of the generator, and each feeder provided with independent pressure regulator or single-phase generators, with single-phase feeders, each feeder being operated with independent pressure regulator.

He said when the increased cost of polyphase line construction is taken into consideration, there becomes quite evident a material advantage for the single-phase motor, even though the first cost of the motor, as compared with a polyphase motor of the same size, may be somewhat in excess of the polyphase motor.

Mr. J. W. Farley presented a paper on "High-Tension Transformers," in which he said in a complete high-voltage electrical power installation there are three distinct elements. These are: (1) The generating plant, (2) the transmission line, with its raising and lowering transformers, and (3) the apparatus for the distribution and application of the transmitted power.

He referred to the question of transmission at voltages in the vicinity of 50,000 and instanced the transmission system of the Shawinigan Water and Power Company, which has been constructed from Shawinigan Falls to Maissonneuve, over 100 miles in length, and which was a 50,000-volt line. Reference was also made to the Montreal Light, Heat and Power Company, which transmits power from its generating plant on the Richelieu River to Montreal, a distance of eighteen miles, at 25,000 volts. The transformers used being of the same general construction as the Shawinigan, and having the greatest capacity of any transformers ever built, namely, 2,750 kilowatts.

Following the lines of the National Electric Light Association, a question box, with a question box editor in charge, was adopted by the association, and will be one of its leading features in future years.

On Friday morning the election of officers took place, which resulted as follows: Mr. J. J. Wright, Toronto, president; Mr. J. B. Thornton, Montreal, first vice-president; A. A. Wright, Esq., M. P., Renfrew, second vice-president; Mr. C. H. Mortimer, Toronto, secretary-treasurer.

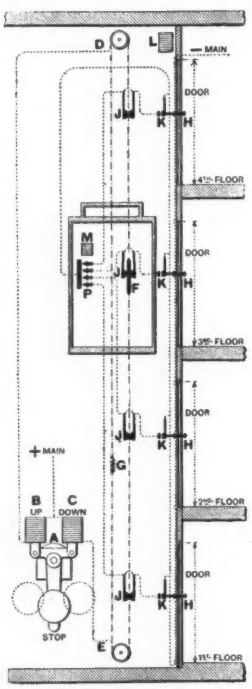
Executive committee: Messrs. John Yule, A. B. Smith, P. G. Gossler, A. A. Dion, Gordon Henderson, B. F. Reesor, C. K. Greene, C. B. Hunt, J. A. Kammerer and H. O. Fiske.

The standard system of accounting for electric lighting companies as recommended by the National Electric Light Association was approved of and recommended for adoption by the association.

After the passing of the usual votes of thanks to those who had done so much to make the meeting of the association a successful one, the convention adjourned to meet in 1904 in the city of Hamilton, Ontario.

Automatic Electric Elevator.

At a recent meeting of the British Institution of Electrical Engineers, a model of an automatic electric elevator was exhibited, the operating circuits of which are shown in the accompanying diagram. At each floor there is located a push-button, similar to the ordinary call bell. There are also at each floor brushes making contact with an endless conductor running over pulleys at the top and bottom of the shaft and attached to and moving with the elevator. This conductor is divided into two sections electrically by two insulating couplings, one of these being within the elevator car. At the top and bottom of the elevator shaft are two brushes pressing upon the endless conductor, and which establish electrical connection between the latter and one side of the supply circuit through two solenoids, shown at B and C in the diagram. The other side of the supply circuit is at-



AUTOMATIC ELECTRIC ELEVATOR.

tached to the push-buttons at the different floors. The operation of the elevator takes place as follows: When one push-button is pressed, connection is made from one side of the supply circuit to the endless moving conductor, and then through one or the other of the two solenoids, depending upon the relative position of the button and the elevator car. Thus, if the elevator is above the floor at which the button is pushed, the circuit will be completed with the lower section of the moving conductor, and through the solenoid C, the starting switch will then be thrown to the right, and the elevator will move down until the insulating section F opens the circuit at the floor from which the call was sent. As soon as this circuit is open, the weight on the starting switch throws this to the off position, and the elevator comes to a standstill.

Within the car are push-buttons from which circuits are run to the various push-buttons on the several floors. When a passenger enters the car he pushes the button corresponding to the floor to which he desires to go, and thus closes the circuit at that point, and the car moves to its proper destination.

Safety circuits are provided which prevent any door from being opened until the car is opposite to that floor, and also lock the push-buttons at all other floors when a call is sent in from any one.

This elevator is known as the Richmond-Carey elevator, and will be put upon the market by Joseph Richmond & Company, Limited, Hatton Garden, London, England.

Aluminum and Bauxite.

The report on aluminum and bauxite for 1902, by Dr. Joseph Struthers, has just been issued by the United States Geological Survey. The production of aluminum in the United States during 1902 was approximately 7,300,000 pounds as compared with 7,150,000 pounds in 1901, the sole producer being the Pittsburg Reduction Company, which has large plants in operation at Niagara Falls and at Shawinigan Falls, Quebec, Canada, and is installing a large plant on the St. Lawrence River, near Massena, N. Y.

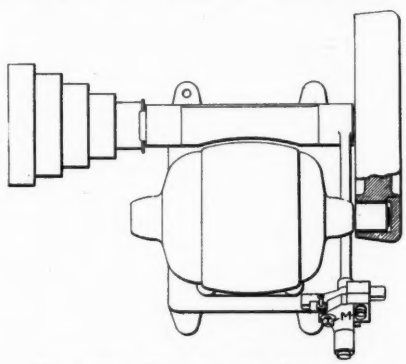
The chief use of aluminum is for the transmission of electrical currents and for alloys possessing exceptionally physical and chemical properties, though a considerable part of the output is manufactured into domestic articles of various kinds. Two growing uses of the metal are for lithographic work and for the production of intense heat by the combustion of the metal as powder.

The production of bauxite during 1902 amounted to 27,274 long tons, as against 18,905 long tons in 1901. Georgia yielded the greater bulk of the product, the remainder coming from Alabama and Arkansas. The consumption of bauxite in 1902 amounted to 43,112 long tons, as compared with 36,218 tons in 1901.

The domestic production of alum and aluminum sulphate in 1902 amounted to 88,614 short tons, valued at $2,238,171, as compared with 82,496 short tons, valued at $2,026,554, in 1901. The imports in 1902 were valued at $16,808, as compared with $20,781 in 1901.

Electrical Patents.

Mr. Norman C. Bassett, of Lynn, Mass., has assigned to the General Electric Company, of New York, a patent for means of electrically operating counter-shafts. The invention relates to mechanism for driving the counter-shafts for machine tools, and the object is to enable such a shaft to be actuated by an electric motor and to be rotated in either direction without reversing the motor. A suitable electric motor of any desired type is mounted on a base-plate which may be secured to a ceiling or wall, as desired. Depending from this base-plate are lugs which support a rocking-frame hinged on an axis parallel with that of the motor-shaft. This frame is provided with a bearing in which is journaled a counter-shaft provided at one end with a stepped cone pulley and at the other end with a driving-wheel or pulley having two oppositely disposed concentric faces with an annular space between them to receive a driving pinion, attached to the motor-

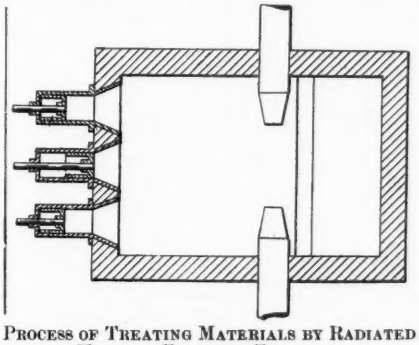


MEANS FOR ELECTRICALLY OPERATING COUNTER-SHAFT.

shaft. The space is wide enough to permit the pinion to rotate without touching either face of the pulley, but a slight movement of the rocking-frame will shift the pulley radially and bring one face or the other into contact with the pinion, the latter being in a radius of the pulley substantially at right angles to the plane of the frame-hinges and counter-shafts. The motor is arranged to run continuously in one direction, and thus when the outer face of the driving pulley is brought against the pinion, the counter-shaft will be rotated in one direction at a certain speed. If, however, the frame is swung so as to bring the inner face into contact with the pinion, the pulley and counter-shaft will be rotated in the reverse direction at a faster speed. Suitable means, either automatic or electrical, are employed for moving the frame and thus swinging the shaft and driving pulley.

Radiated heat generated from an elec-

tric arc, from electrically heated conductors or by means of electric induction and reflected from the walls of the furnace may be employed, as is well known, for treating materials of different kind, as, for instance, for producing calcium carbide, for extracting metal from their ores, etc. If, however, the material, which is charged in a finely crushed condition, be placed near to the source of heat, the development of gases generated by the chemical processes is very violent, causing the material to be thrown about in all directions in the furnace, resulting in great inconveniences. If, for instance, the treatment has for its object the distillation of volatile metals—as zinc, lead, etc.—part of the material will follow the metal vapors, which are thus rendered impure or imperfect. If the invention has for its object the extraction of involatile metals, such as iron, the slag will be damaged by the material thus thrown about, which also will follow the escaping gases occurring from the process, thereby occasioning a loss. In order to conduct the



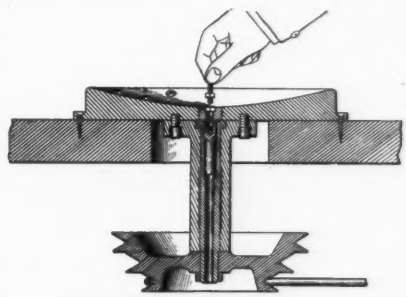
PROCESS OF TREATING MATERIALS BY RADIATED HEAT IN ELECTRIC FURNACE.

process continuously and undisturbed, it has proved necessary to place the material in the electric furnace in such a way that the chemical processes (the development of gases and vapors) are carried out at a certain distance from the source of heat and with moderate violence, while the melting of the mineral and of the ingredients forming the slag takes place nearer to the source of heat. In a process invented by Mr. Carl Gustaf Patrik De Laval, of Stockholm, Sweden, this is accomplished by placing the material in the electric furnace so as to constitute a pile or stack with a sloping side, which is maintained at a practically constant distance from the source of heat by continuously introducing material at the back of the stack, so as to continuously push the stack forward, corresponding to the melting action of the source of heat upon the surface of the slope. The chemical processes are effected at the surface of the slope, from which gases and vapors escape, while the involatile ingredients of the charge (the mineral, involatile metals, etc.) slide down the slope to its base, where they melt and are exposed to the intense heat of the electric source of heat without being disturbed by any development of gases, which, as above stated, takes place at the surface of the slope. When the processes have continued some time, a layer of molten or half molten material is formed, having a slow motion down the slope and covering the pulverulent material. It is important for the undisturbed proceeding of the treatment that the introduction of fresh material at the back of the stack be performed uniformly and with proper speed. The mechanical arrangements for carrying out the continuous introduction at the back of the stack may consist in reciprocating pistons, rotating transport screws, or the like; but the invention is not limited by any certain arrangement for this purpose.

Mr. Samuel F. Short, of New York, N. Y., has obtained two patents on power-wrenches, employed for quickly assembling small nuts upon the shanks of shoes. Work of this character has heretofore been done by hand, but by means of these machines the manual labor and time required are very greatly reduced. In the first and simplest invention, a bed-plate of circular form is employed, which is secured horizontally upon a table and has a dished or concave upper face. A vertical spindle is mounted to rotate in a suitable bearing below the centre of the bed-plate and a wrench-spindle or chuck is carried by the upper end thereof, being located in the centre of the bed-plate and having its upper end flush with the concaved face thereof. This spindle or chuck has a nut-shaped recess or wrench-socket formed therein. The spindle may be driven by any suitable means, as, for instance, a belt passing about a pulley attached to the lower end thereof. The operation of the device is as follows: The operator sprinkles a number of nuts on the bed-plate and with the forefinger of the left hand slides one of them down into the rotating wrench-socket. Then he inserts the shank of the screw, which he is holding in his right hand, into the eye of the nut, and the nut is rapidly and automatically screwed on. When it is well on the shank of the screw, the operator simply pulls out the assembled screw and nut, tosses them into a box, slides another nut into the socket and repeats the operation. In accordance with the other invention, a wrench, which preferably consists of a chuck and a spindle with a socketed head held frictionally thereby, is arranged to be rotated by suitable driving mechanism, and the nuts are fed into an adjacent guideway, from which they may be engaged by the end of a threaded screw-shank held in the hand of the operator and moved one by one into the rotating wrench-socket, whereby they are rapidly and automatically screwed upon said shank. The advantage of the wrench being held frictionally instead of rigidly by the chuck is that the operator is not required to pull the nut out of the socket at any certain instant, but may wait until it has been screwed on as far as it will go, whereupon the wrench will remain stationary while the chuck continues to rotate, slipping relatively thereto.

Single-Phase Traction Motors.

Dr. Finzi, a member of the firm of Brioschi, Finzi & Company, of Milan, Italy, is developing a single-phase alternating-current motor for railway work. The type being studied is the ordinary



POWER-WRENCH.

series continuous-current motor, operating on a low frequency. One of these has been constructed, and under test it operated sparklessly. The characteristics were much the same as those of an ordinary series motor. This motor runs on 200 volts, at a speed of 750 revolutions per minute, and develops twenty-five horsepower. The weight is 1,500 pounds. It has six poles. As it runs above synchronous speed, a good power-factor is secured. The details of design adopted for this motor are insulating the laminations of both field and armature carefully, slotting the pole-faces in a longitudinal direction to oppose the transverse flux, and introducing a fairly high resistance into the bars leading to the commutator. It is expected that a trial will soon be made on the Milan Railway system. Although this motor has been designed for very low frequencies, Dr. Finzi believes that he can get good results with frequencies of twenty-five cycles per second.

The Convention of the New York State Independent Telephone Association.

The adjourned annual meeting of the New York State Independent Telephone Association was held at the Butterfield House, Utica, N. Y., Wednesday, June 10, 1903. A spirit of entire harmony prevailed during the sessions, and the differences which had for some time existed between this association and its contemporary were amicably settled, and the two societies were merged into a united body of great strength.

The first session of the convention was called to order at 2.15 P. M. Mr. George R. Fuller, of Rochester, N. Y., president of the association, was in the chair and delivered the opening address. Since the organization in July last, exchanges have been opened and are being operated in Buffalo, Albany, Troy, Elmira, Binghamton, Jamestown, Ithaca, Canandaigua, Penn Yan, Lockport, Batavia, and dozens of smaller towns in the state, representing in all a million or more. To these should be added Niagara Falls, Medina, Albion, Brockport, Rochester, Geneva, Auburn, Syracuse and many other populous towns throughout the state, where prosperous exchanges were in operation previous to a year ago. He prophesied that the announcement of the next annual meeting would be made over independent lines to every member of the association, and made a number of suggestions with regard to the schedule of dues and the equitable distribution of the burden of expense, in proportion to the strength of the companies represented. He thought it would be advisable to amend the constitution so as to provide for the acceptance, as members, of the manufacturers of telephone apparatus and supplies, giving them an opportunity for the submission and discussion of papers relating to the welfare of the association and its members, without the right to vote.

The roll call by the secretary found practically all of the members present. The report of the secretary-treasurer was read, and referred for ratification to the Auditing Committee. This committee consists of Messrs. Boyd McDowell, of Elmira, and Potter, of Syracuse. The Auditing Committee later on making a favorable report, the treasurer's report was accepted. An able paper was read by Mr. Charles O. Harris, the secretary-treasurer, showing the independent growth in the state of New York.

A committee, composed of Messrs. Brush, Ferris, Davis, Edwards and Brailey, was appointed on membership and credentials. This committee reported and recommended, after a session with a similar committee of the Buffalo Independent Association, the amalgamation of the two associations and the adoption of the following resolutions:

That all members of the Buffalo association become, and are hereby made, members of this association, subject to the ratification of their respective companies; and also be it

Resolved, That all the independent companies represented here to-day become, and are hereby made, members of this association, subject to the ratification of their respective members or directors.

These resolutions were unanimously adopted.

A constitution amendment committee was appointed by the chair, on motion of Mr. McDowell. This committee was composed of Mr. McDowell, chairman; Mr. Hendrickson, of Albany; Mr. Carey, of Buffalo; Mr. Aiken, of Auburn, and Mr. Barber, of Wauseon, Ohio. A nominating committee of seven was appointed by the chairman, consisting of Messrs. Persons, Davis, Pool, Edwards, Hubbell and Brailey, and Mr. Griswold, who, as chairman, reported the nominations as follows:

For president, George R. Fuller, of Rochester; first vice-president, Howard Hendrickson, of Albany; second vice-president, J. H. Schofield, of New York city; secretary-treasurer, J. B. Ware, Buffalo. Executive committee: H. R. Persons, Buffalo; B. G. Hubbell, Buffalo; S. B. Rawson, Niagara Falls; Edward Davis, Binghamton; T. H. Ferris, Utica; J. S. G. Edwards, Gloversville; J. S. Brailey, Jr., of Herkimer, and T. S. Lane, of Jamestown. Inspectors: C. H. Pool, Utica, and C. O. Harris, Rochester. These gentlemen were unanimously elected.

The delegates and their friends were invited by Mr. Ferris, in the name of the Utica Home Telephone Company, to be present at the reception given at the company's exchange, at 7.30 P. M.

Mr. Martin Carey, attorney for the Frontier Telephone Company, made a short speech, followed by former Senator Persons, vice-president and general manager of the Frontier Telephone Company. A paper on "Uniformity in Toll Service" was read by Mr. Potter, and Mr. J. B. Ware gave a short talk on "Telephone Development in the East," when the meeting was adjourned until 7.30 P. M.

The evening session was held in the Home Telephone Company's exchange. The first business was the report of the committee on amendments, which was adopted. This provides that the annual meeting be held the first Thursday in June, and that the annual dues be payable the first of January each year. Refreshments were provided by the Utica Telephone Company, and many courtesies were extended to the visiting telephone men. The meeting adjourned early in the evening, but many of the delegates were guests of the company until a late hour.

Among those present at the convention were:

S. A. Coe, secretary and treasurer Orleans County Rural Telephone Company, Lyndonville, N. Y.; Charles H. Poole, Utica Home Telephone Company; T. Harvey Ferris, Utica Home Telephone Company; W. D. Fuller, Norwood Telephone Company, Norwood, N. Y.; B. H. Brownell, president Rural District Telephone Company, Morton Telephone Company, Buffalo, N. Y.; J. B. Ware, Inter-Ocean Telephone Company, Buffalo; B. G. Hubbell, president of the Consolidated Telephone Company, Inter-Ocean Telephone and Telegraph Company, Geneva Telephone Company, Utica Telephone Company, Corning Telephone Company, Penn Yan Telephone Company and other exchanges; F. H. Sudro, Citizens' Standard Home Telephone Company, New York city; J. F. Spockwell, Ontario Telephone Company, Oswego, N. Y.; J. A. Crawford, Franklin County Telephone Company and Racket River Telephone Company, Hamden, N. Y.; J. S. Edwards, Glen Telephone Company, Johnston, N. Y.; E. C. Aiken, president Auburn Telephone Company, Auburn, N. Y.; E. L. Barber, Rome Telephone Company, Rome, N. Y.; J. S. Brailey, Jr., the Herkimer County Telephone Company; H. H. Pearson, Frontier Telephone Company, and Haines Telephone Company, Buffalo, N. Y.; Boyd McDowell, secretary Elmira Telephone Company, Elmira, N. Y.; Wm. C. Geer, Rensselaer Telephone and Telegraph Company, Troy, N. Y.; W. Lewis Burk, Saratoga Telephone and Telegraph Company, Saratoga Springs, N. Y.; F. M. Brush, Cohoes, Waterford Home Telephone Company, Elyria, Ohio; J. Fagen, secretary County Telephone Company, of Herkimer; J. H. Griswold, West Shore Telephone Company, Catskill, N. Y.; Howard Hendrickson, Albany Home Telephone Company, Albany, N. Y.; H. J. Prince, Jr., Watervliet, Green Island Telephone Company, N. Y.; S. M. Strong, secretary and manager Schenectady Home Telephone Company, Schenectady, N. Y.; F. E. Hicks, president Granville Telephone Company, Granville, N. Y.; John A. Driscoll, Seneca Gorham Telephone Company, Ontario County, N. Y.; D. Odell, manager the Rome Home Telephone Company, Rome, N. Y.; J. B. Marquis, Jr., Marquis Telephone Line, Norwich N. Y.; F. A. Smith, manager New Berlin Telephone Company, New Berlin, N. Y.; George G. Otis, secretary Colonial Telephone Company, Newburgh, N. Y.; W. W. Capron, treasurer Oneonta Telephone Company,

Oneonta, N. Y.; Sam B. Rawson, Independent Union Telephone Company, Elmira, N. Y.; J. H. Griswold, Dunkirk Home Telephone Company, Dunkirk, N. Y.; W. H. Kelley, manager Newark Telephone Exchange, Newark, N. Y.

Evan Shelby, Sterling Electric Company, La Fayette, Ind.

S. C. Platt, Kellogg Switchboard and Supply Company, Chicago, had an exhibit of the company's goods at the Baggs Hotel.

G. H. Miller, of Norwalk, Ohio, had a line of Miller guy anchors on exhibit.

William G. Mills represented the American Novelty and Manufacturing Company, of New York city.

The North Electric Company, of Cleveland, Ohio, was represented by Raymond Hendrickson, with a line of the North apparatus. He gave the friends of the company a model gold-plated telephone transmitter arranged in the form of a button.

John H. Reed represented the American Electric Telephone Company.

George H. Pierce and Eugene L. Brown had wired up and in working order a full line of Stromberg-Carlson telephones. The telephones were wired into the Home Telephone Company's new exchange, and over them one could talk to any part of the city. When a visitor wished to see a switchboard of this manufacture he was taken to the new Home Exchange, where the Stromberg-Carlson company has very recently installed a ten-section central energy board. A new lock-out device being put on the market by this company attracted considerable attention.

International Telegraph Conference.

The ninth annual Telegraph Conference began in London, May 26. The proceedings were opened by the Right Hon. Austin Chamberlain, who welcomed the delegates from foreign countries. The proceedings were private, but the following official statement was supplied to the press:

In welcoming the delegates the Postmaster-General referred to the importance of the matters which they had met to discuss, and wished them success in their labors, which had for their object the amelioration of international telegraphs in the interests of the public. Dr. Hennyey de Hennye, the principal delegate of the Hungarian Administration, responded in eloquent terms to the address of the Postmaster-General, and, as the representative of the administration which last entertained the conference at Budapest, gave a résumé of the events affecting the international telegraph convention which had occurred since the last conference. M. Delarge, the senior delegate of Belgium, and *doyen* of the conference, followed with a friendly speech; and M. Pereira, the delegate of Portugal, also thanked the Postmaster-General for the welcome which he had extended to the delegates, and joined in the wish that the result of the conference would be beneficial to the telegraph world. The business of the conference will go on from day to day until the end of June. Mr. J. C. Lamb, C. B., C. M. G., the principal delegate of Great Britain, was chosen president of the conference, and Mr. John Ardron and Mr. P. Benton, vice-presidents. The following presidents of committees were appointed: M. Delarge (Belgium), M. Sydow (Germany), M. Neubauer (Austria), M. Bordelongue (France), and these gentlemen are to be assisted by the following vice-presidents: M. Gvozditch (Servia), M. Sevastianoff (Russia), M. Pop (Netherlands) and M. Pereira (Portugal).

The secretarial duties of the conference will be carried out by the International Telegraph Bureau of Berne, which is represented by M. le Colonel Frey, the distinguished director of the bureau; M. Eschbaecher, the vice-director, and M. Homberger. On the nomination of the president, Mr. N. Hautrive, Mr. J. I. De Wardt and Mr. J. F. Lamb, of the General Post Office, London, were appointed as the British secretaries to the conference.

The results of the conference will be embodied in revised service regulations attached to the international telegraph convention of St. Petersburg.

The following states were represented:

Argentine Republic, Austria, Belgium, Bosnia-Herzegovinai, Brazil, Bulgaria, Cape of Good Hope, Ceylon, Commonwealth of Australia, Crete, Denmark, Dutch East Indies, Egypt, France and Algeria, Germany, Great Britain, Greece, Holland, Hungary, India, Indo-China, Italy, Japan, Luxemburg, Madagascar, Montenegro, Natal, New Caledonia, New Zealand, Norway, Persia, Portugal, Portuguese Colonies, Roumania, Russia, Senegal, Servia, Siam, Spain, Sweden, Switzerland, Tunis, Uruguay, and the United States.

The object of these conferences is the amelioration of international telegraphs in the interest of the public. The first of these was held in Paris, in 1865. Since then they have been held from time to time in different cities. These conferences have formulated various rules for the safe and prompt despatch of telegrams and bases on which charges are made.

Many matters came up for consideration, and while these related principally to the administration, rather than engineering, they doubtless had a bearing on telegraph and telephone engineering questions. The proposed enforcement of a compulsory vocabulary for coded messages was thoroughly discussed, but no agreement was reached.

The Independent Telephone Association of the United States.

The seventh annual convention of the Independent Telephone Association of the United States will be held in Chicago, Ill., June 24 and 25. The headquarters of the convention will be at the Auditorium Hotel. The general committee in charge of the arrangements anticipates a most enthusiastic and interested gathering, and is completing its facilities for the proper entertainment of the delegates and attendants.

The following gentlemen compose the general committee: J. G. Ihmsen, chairman; H. D. Critchfield, Henry Shafer, C. J. Stiger, Kempster B. Miller, W. A. Kriedler, John R. Dare and H. B. McMeal.

The following programme has been announced:

June 24, 2 P. M.—Address of welcome by the Hon. Carter H. Harrison, Mayor of Chicago; response by the Hon. S. P. Sheerin, of Indianapolis, Ind.; annual address by President James M. Thomas; roll call of states, and reports; paper on "Advantages of Association" by Hon. C. E. Hull, Salem, Ill., president Interstate Independent Telephone Association; "The Telephone and the Technical School," by J. C. Kelsey, professor of telephony, Purdue University, La Fayette, Ind.; "Modern Exchange Construction," by W. H. Johnson, general superintendent Frontier Telephone Company, Buffalo, N. Y.; "Independent Telephone Development in the South," by C. E. Stinson, general superintendent Memphis Telephone Company, Memphis, Tenn.; "Western Telephone Development," by J. S. Bellamy, Knoxville, Iowa. There will be a concert in the Auditorium Hotel at 6 P. M., and at 8 P. M. a special train will start for San Souci Park, the programme of entertainment to be given later.

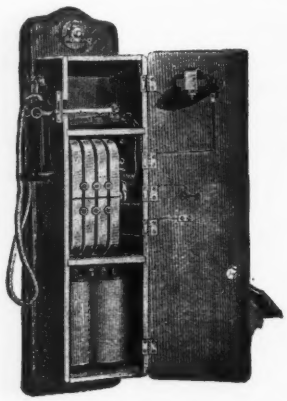
June 25, 2 P. M.—"Committee Report on Patent Litigation," by the Hon. Hugh Dougherty, Bluffton, Ind.; "Telephone Discipline," by C. E. Tarte, general manager Citizens' Telephone Company, Grand Rapids, Mich.; "Eastern Telephone Development," by F. A. Demarest, general manager Interstate Telephone and Telegraph Company, Trenton, N. J.; "Present and Future," by Frank L. Beam, Columbus, Ohio. This will be followed by general discussion and the election of officers.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Double Four-Bar Generator.

The Connecticut Telephone and Electric Company, Meriden, Ct., is introducing a new and novel idea in generator construction. The accompanying illustration shows a new instrument which this company is placing on the market, which is made up with two four-bar generators placed end to end, making an exceedingly powerful field. The company states that this generator has a current



DOUBLE FOUR-BAR GENERATOR.

output of about twenty per cent greater than any five-bar generator on the market. The generator has many features, the principal one being its compact design, obviating the use of a large containing-box. The instrument is especially made for heavily loaded country lines. The magnets are polished and heavily nickeled, and the electrical and mechanical construction is claimed to be of a high grade of merit.

The Thomas S. Clarkson Memorial School of Technology.

The catalogue of the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., describes the courses offered in civil, electrical, mechanical and domestic engineering. The outline of these indicates that the work conducted at the school is well planned to give the student a thorough training in his subject. A summer school will be inaugurated this year, beginning July 8, 1903, and extending for six weeks. In this, courses are offered in mathematics, physics, chemistry, electricity and electrical engineering, and domestic science and economy.

Telephone Cable Splicing.

The accompanying illustrations show some interesting cable work recently done by W. H. Crumb & Company, Chicago, Ill., for the Illinois Telephone and Telegraph Company at the new automatic exchange, Chicago, Ill. Fifty 200-pair cables are brought into the exchange building from the tunnel, and distributed on racks in the basement, and carried along the side wall of the first floor to the main distributing frame located on

CABLE SPLICING AT THE EXCHANGE OF THE ILLINOIS TELEPHONE AND TELEGRAPH COMPANY, CHICAGO.

the second floor. For connection to the main distributing frame, each underground cable is spliced to eight twenty-five-pair switchboard cables enclosed in lead sheathing. After the splices were made, the cables were bent down under a false floor, and the twenty-five-pair branches were brought out beneath the main distributing frame, one branch connecting to each vertical block on the frame. In order to economize room, the cables being spaced on six-inch centres, it was necessary to splice the cables in an upright position, as shown in the illustrations.

Cable Splicing at the Exchange of the Illinois Telephone and Telegraph Company.

Four-inch lead sleeves were used for making the splices. These were drifted to four and one-half inches diameter on the top. After the wires had been spliced and the lower soldered joints wiped, three-eighth-inch circular wooden blocks, each containing eight holes for the twenty-five-pair switchboard cables, were placed in the upper ends of the lead sleeves to prevent the solder from flowing into the splices. The lead sheathing was then drawn on to the switchboard cables and neatly fitted into the holes in the wooden blocks, a space of about two inches being left between the upper surface of the wood and the top of the sleeve. Extra fine solder—about eighty per cent tin and twenty per cent lead—was then poured into this space, completely filling it. This was sweated to the twenty-five-pair cables and the lead sleeve, completely sealing the joint. After the joining had been completed, the upper ends of the cables with the joint were laid in a horizontal position on the floor, so that the branches would extend through the false flooring to the main distributing frame. The splices were then filled with paraffin, and the pair wires left for proper connections.

New Type Receiver.

The accompanying illustration shows one of the latest and most improved types of telephone receivers placed on the market by the Century Telephone Construction Company, Buffalo, N. Y. The company states that this receiver has met with considerable success throughout the telephone field. The receiver is of neat design, is very powerful and sensitive, and the construction is such as to render it mechanically and electrically correct. The shell is of the best hard rubber, with concealed binding-posts, and the adjustment is permanent. The pole-pieces are of the best grade Norway iron, and the spools are wound with silk-covered magnet wire, the magnets being made of high-grade magnet steel.

New Type Receiver.

The illustration shows the manner in which the receiver cord is attached. This also shows the novel way of attaching the diaphragm cup to the magnets, so that the spools and all the connections are protected in every way.

The entire mechanism of the receiver slips from the shell, the pole-pieces and the diaphragm cup are ground to an absolute adjustment, and there is no possible way for this adjustment to change on account of any influence.

The Dan River Power and Manufacturing Company will equip its cotton mill at Danville, Va., with electrical machinery throughout, and for this purpose has recently ordered from the Westinghouse Electric and Manufacturing Company two 750-kilowatt and one 500-kilowatt, 6,600-volt generators, together with two 125-kilowatt exciters, each generator to be direct-connected to an independent water-wheel. The current so generated is to be transmitted a distance of 3,000 feet to a step-down transformer station, in which will be located four 600-kilowatt, oil and water-cooled transformers, which will step down the 6,600 volts to approximately 500 volts. From these transformers the current will be carried to a substation switchboard, from which lines will run through an underground vitrified conduit transmitting the current to the various buildings where it will be used for driving the numerous induction motors which will drive the cotton mill machinery.

Efficiency Tests of Tangential Water-Wheels Operating under 1,912 Feet Effective Head of Water.

Recent development in hydraulic practice on the Pacific coast has been in the tendency of the utilization of higher heads. In the minds of a number of engineers the question has arisen as to the wisdom of developing these high heads, utilizing the totality of fall in one station, as against dividing the fall up and passing the water through two or more stations in series, in this way utilizing the same water under lower heads in two or more power plants.

The Edison Electric Company, of Los Angeles, Cal., had this problem to consider when it was proposed by it to install its new power plant, which has been known as Mill Creek No. 6, it being located in the Mill Creek Cañon, near Redlands, Cal., the effective head on this plant being 1,912 feet. After carefully considering the matter the Edison Company decided that it would be better engineering to utilize the total available head in one power station. It also concluded that, as it had several other power plants to build, this would be an excellent opportunity to test the relative merits of the different water-wheels on the market.

The plant to be installed by it was to consist of four water-wheel generating units of 750 kilowatts each, designed for a twenty-five per cent overload, at a turning speed of 430 revolutions per minute. It therefore decided to install at first but two units. Accordingly it placed an order for one unit with the Abner Doble Company, San Francisco, maker of the ellipsoidal tangential water-wheel, and one other company, at the same time taking an option from each firm for two additional wheel units with the agreement that the order for the additional wheel units would be placed with the engineering firm furnishing the wheel unit of the best engineering design, workmanship, efficiency, and giving the most satisfactory results when in operation.

The initial wheel units have been installed and tested, and have been in operation for several months, and it is stated that, based on the results secured from these two wheel units, the power company exercised its option, placing the order for the balance of the wheel units with the Abner Doble Company.

At loads from one-half load to over twenty-five per cent overload the Doble wheel showed an efficiency on the preliminary tests of from eighty per cent to eighty-four per cent. The generators in this plant were furnished by the General Electric Company.

The nozzle used on this machine is of the Doble patented needle regulating type, which gives a favorable efficiency curve with variable load, the water consumption of the unit being almost strictly proportional to the power output of the generator.

The Public Accountant in the Electrical Industries.

To meet the competition incident to the great development of the electrical industry, and to safeguard the large amounts of capital invested, there has developed on the part of soundly managed enterprises the demand and need to ascertain accurately the cost of production, expense of administration, expense of selling, general expenses, etc. Some method of figuring cost prevails in many establishments, but too often this is inadequate or actually misleading, because the prime requisites of cost accounting are overlooked, namely, that it must be supported and proven by the financial accounts and by a system of actual stock account keeping. Here the public accountant becomes of value, his professional training and experience fit him to adapt methods and systems to meet the requirements of any particular business.

The efficient work in this direction and field of Mr. W. F. Weiss, certified public accountant of 128 Broadway, this city, for some fifteen years has caused him to become well and favorably known in the electrical industry, his record pointing to numerous instances where the expense of his employment has proven economical and a profit returning investment, aside from the additional satisfaction that the management of a business derives from a thorough and absolute control of all its details.

The Kellogg Switchboard and Supply Company.

A disagreement among the stockholders of the Kellogg Switchboard and Supply Company has resulted in a suit being brought by the minority stockholders in the name of Messrs. Kempster B. Miller, F. J. Dommerque and F. W. Dunbar, to restrain the majority interests from disposing of the control of the company. A temporary injunction was granted by Judge Tuley on June 5. The Kellogg company, it is announced by the president, Mr. W. L. De Wolf, will continue its business as heretofore, fulfilling all contracts and supplying apparatus as required. It is one of the best-known manufacturers of independent telephone apparatus in the field, and has large factories in Chicago, and agencies in a number of the leading cities of the United States.

Creosoted Wood.

The Wyckoff Pipe and Creosoting Company, Stamford, Ct., has for a number of years been supplying the market with tubes for electrical conduits. The ducts furnished by this company are made of wood creosoted with dead oil of coal tar. The wood, properly creosoted for the purpose for which it is to be used, is said to be practically indestructible.

The preservation of wood is an old art, and has been practised since the beginning of the eighteenth century. The company has, from time to time, issued interesting information on this subject, from which the following data have been abstracted. In 1705 Homberg soaked wood in a weak aqua solution of corrosive sublimate. In 1730 Job Baster treated wood for shipbuilding purposes with a diluted solution of corrosive sublimate and arsenic. In 1740 Reed used vinegar, and Fagot used alum, iron vitriol and steam. This experiment of Fagot in 1740 is the first noticed with the use of steam for the preservation of wood. In 1756 Hill treated wood with a solution of tar oil and wood vinegar. About this time a process generally used for preserving wood was by dipping it in boiling hot wood tar. In 1756 Jackson used a mixed solution of sea salt, lime, sulphate of zinc, alum, Epsom salt, ashes and sea-water. From 1767 to 1812 the solutions given above were used in a variety of ways. In 1812 coal tar was first used by Cook for the preservation of ships and ship timber. In 1823 Oxford used for the first time oils distilled from tar, applying them to the wood as paint. In 1835 Moll was the first to use the vapors of wood tar and creosote, the wood being enclosed in tight chambers. In 1848 May treated wood according to the present method, with heavy tar oils of creosote. The wood was first subjected to superheated steam, and then creosoted vapors in a cylinder, under pressure.

The Wyckoff Pipe and Creosoting Company has been very successful in the processing of wood for resisting the deleterious action of the elements.

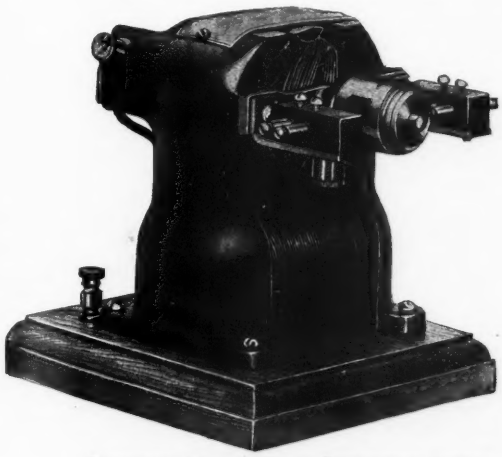
The company is now getting out several thousand feet of conduit for the New York & New Jersey Telephone Company, to be used in New Jersey and on Long Island. These conduits are laid with one creosoted plank on top, to protect them. The same company is also furnished with thousands of creosoted arms. After an experience of several years it has been found that these do not rot, and have saved thousands of dollars for renewals,

because the creosoted cross-arms have lasted for years, giving a very much increased length of service over the uncreosoted wood.

The Wyckoff Pipe and Creosoting Company was incorporated under the laws of the state of Connecticut on June 4, with a capital stock of $90,000. A recent letter from the executive officers of the New York & New Jersey Telephone Company states that some of this conduit, laid as early as 1884, upon recent examination has shown no sign of deterioration, and that this system of conduits has proved entirely satisfactory.

Combined High and Low-Frequency Ringer.

The accompanying illustration shows a new type of special ringing machine which is being placed on the market by the American Electric Telephone Company, Chicago, Ill. While the illustration shows but one commutator, which is for the low frequency, this machine is of such novel



COMBINED HIGH AND LOW-FREQUENCY RINGER.

construction that two commutators are afforded, making it a special machine for high and low-frequency currents.

This selective ringing machine operates from primary or storage battery current, and acts as a pole-changer, with dry batteries to supply a ringing current, giving alternations of either 2,400 or 7,200. The machine is efficient in operation, and is of ample capacity for small exchanges, or as an auxiliary machine for large plants. The demand for party line service is increasing the use of these selective ringing machines, and this one, the company states, has been used with more than ordinary satisfaction.

The official time fixed for the opening of the London-Brussels submarine cable was June 8. The formal inauguration of the Rome-Paris cable was June 7.

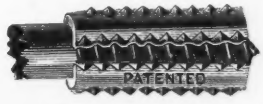
Expanding Sleeves for Telephone Construction Work.

In the accompanying illustrations are shown the improved solid expanding sleeves and triple expansion sleeves placed on the market by James S. Barron & Company, New York city. These are used for fastening telephone backboards, switches, bells, push-buttons and all kinds of electric fixtures to stone,

TRIPLE EXPANSION SLEEVE.

brick, terra cotta, concrete, plaster and tile. These expanding sleeves are not threaded, but are made to engage any thread on any kind of screw that may be used, the device expanding equally well with any kind of thread. In using this apparatus, a hole is drilled into the material which is to hold the instrument, the sleeve is inserted, and the screw then driven into the expanding sleeve which, by nature of its construction, fills up the hole so made, making a permanent connection.

The triple expansion sleeves are made



EXPANSION SLEEVE.

of malleable iron, in two parts which interlock, preventing their being affected by severe vibrations. These are designed for use in installing dynamos, motors, engines, and other heavy machinery, where a considerable strain comes on the bolts.

The Philadelphia Branch of the American Institute of Electrical Engineers.

The regular meeting of the Philadelphia branch of the American Institute of Electrical Engineers was held at Drexel Institute, Philadelphia, Pa., on Monday evening, June 8. The meeting was well attended, there being over 300 visitors and members present. Mr. William J. Hammer gave his famous lecture on "Radium and Other Radioactive Substances." Mr. Hammer's lecture was freely illustrated by experiments and lantern slides, and this feature of the meeting was greatly enjoyed by every one present.

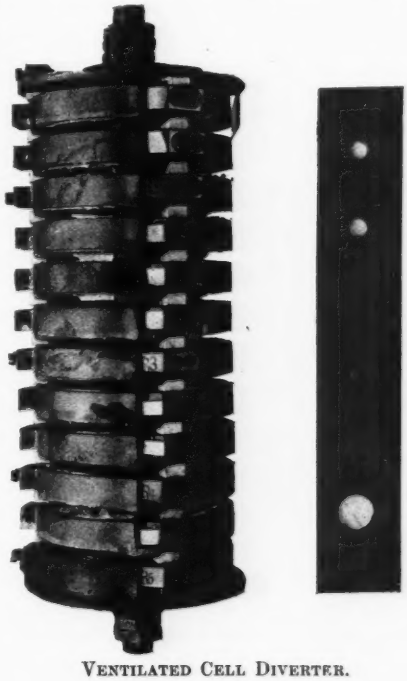
Mr. Joseph Menchen, of New York, through his representative, Mr. Eckhardt, gave a number of examples of the way in which electricity is made use of on the stage. Various scenic effects were shown, and the apparatus was inspected by the members after the meeting.

The next meeting of the Philadelphia branch will be held in September.

Ventilated Cell Diverters.

The ventilated cell diverters manufactured by the Westinghouse Electric and Manufacturing Company, express some of the latest and best ideas in this form of electrical apparatus, answering the demands for capacity, insulation, durability, and economy of cost, while maintaining good mechanical design and features.

The individual cells are separated, permitting a free circulation of air around each cell, and may easily be renewed if



VENTILATED CELL DIVERTER.

injured or worn out. Solid insulating blocks are placed between the cells, and solid insulating washers under the nuts at the ends of the columns. The end of the resistance strip is brought out through a slot in the cell casting and connected to a boss by means of a washer and two screws, giving the contact great permanency and rendering it unaffected by long exposure to severe climatic conditions.

The whole apparatus is compact and durable, arranged in several units for convenience in mounting, and admirably adapted for all kinds of outdoor service, no material of either a hygroscopic or a combustible nature being used in the construction.

The Chicago Telephone Holder.

From time to time complaint has been made of the alleged difficulty of inconvenience in the shape of a desk telephone, due to its interfering with the desk apparatus and furniture. There is not only liability of the instrument being acci-

FIG. 1.—DESK HOLDER, IN USE.

dentally thrown from the desk, but trouble has also been experienced from broken and twisted cords. The Chicago Writing Machine Company, Chicago, Ill., has designed and is marketing a telephone holder, the function of which is to obvi-

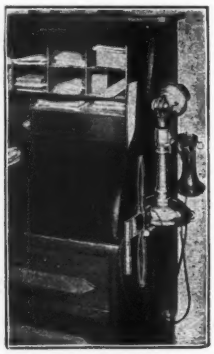


FIG. 2.—DESK HOLDER, OUT OF THE WAY.

ate any of these inconveniences. One of the best features of this desk set is that it saves time in answering a call, and with the telephone holder, the reply is as

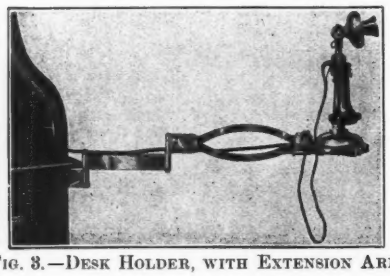


FIG. 3.—DESK HOLDER, WITH EXTENSION ARM.

expeditious as it is possible to make it. The telephone is held securely in place, out of the way when not in use, ready to be swung around in front of the subscriber whenever necessary.

The accompanying illustrations show the manipulation of this telephone holder, and the manufacturer claims that its chief features are simplicity, strength and convenience. The apparatus allows the telephone to be pushed back or extended at will. In Fig. 1 is shown an ordinary desk holder in use, Fig. 2 showing holder pushed out of the way. Where added length is needed, so that the telephone may be used between two adjoining desks, or where it is desired to attach the holder to the wall, an additional arm is used. This is shown in Fig. 3. The base clamps are made so adjustable that they fit any diameter or thickness of base, and will hold any telephone securely.

Party Line Service.

The Boston Telephone Selector Company, Boston, Mass., has had in operation

FIG. 1.—PARTY LINE LOCK-OUT INSTRUMENT.

in a number of exchanges a party line selective signaling system which is claimed to have met with entire success. To be satisfactory, a party line system should be selective signaling. When two subscribers are using a certain line, all other subscribers should be locked out, and means should be provided to warn the subscriber if the line is in use. In the accompanying illustrations is shown the apparatus manufactured by this company. Fig. 1 shows a general view of the instrument, and the way it is mounted. Fig. 2 shows the same instrument with the cover removed, showing the mechanical parts of the apparatus. Fig. 3 is a detailed view showing the special operating parts.

The operation of this apparatus is as follows: The subscriber, by removing the receiver, signals "central" and locks all instruments on his line, and "central," in signaling the called subscriber, locks all other subscribers from that line, displaying "busy" in each case. The two parties can

FIG. 2.—LOCK-OUT INSTRUMENT, WITH COVER REMOVED.

then communicate with privacy and without interruption. When either receiver is hung up, the clearing-out signal is displayed, thus making it doubly supervisory. The operator then restores each line to normal. Should the operator take down a connection without restoring the lines, the line signals will be displayed, and can only be cut out by restoring the instruments to their normal condition. Intercommunication is possible only through the cooperation of central. An automatic key is provided for each operator, which selects and rings any instrument by pressing a button numbered to correspond with the station desired, and manipulating the ringing key

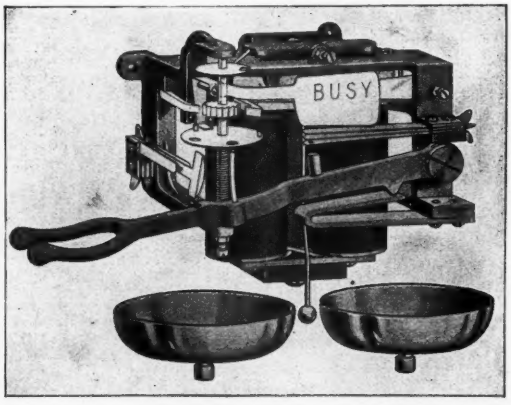


FIG. 3.—SHOWING OPERATING PART.

in the usual manner. One pair of magnets is all that is necessary to operate the selector and ring the bell.

Twin Generators for Turbines.

The Northern Electrical Manufacturing Company, Madison, Wis., has for many years been making a line of direct-current generators which has met with more than ordinary success. The accompanying illustrations show two new pieces of apparatus which this company is placing on the market in order to accommodate high-speed turbine practice, Fig. 1 showing a twin generator, the total capacity of which is 200 kilowatts at 900 revolutions per minute. This machine is built especially for steam turbine engines. Fig. 2 shows the twin fields, poles and brush-holders complete, ready for the armatures.

The construction of these machines is similar to that of the standard Northern high-speed generators, with such modifications as the character of the machines requires. The commutator is extra wide, and the brush-holder equipment is increased in proportion.

The poles are laminated and so secured in the frames as to permit their removal on occasion, without the necessity of disturbing the armature. The field coils are readily removed from the pole-pieces after the latter have been taken from their positions in the field. All parts subject to increased temperature are thoroughly ventilated, and ample bearings are provided.

While the standard high-speed generator manufactured by this company has been described before, a description of some of the prominent features will be of interest. The field frames are cast from special grades of metal having a high magnetic permeability. The quality of the metal is closely inspected and sustained by chemical analysis. Strict attention is paid to the castings, which are of uniform grade, and all of the faces are accurately machined.

Great care is taken in the construction of the field coils. The shunt and series coils are wound separately, and are so arranged on the poles as to allow of the best possible ventilation. The shunt coils are accurately form-wound, of insulated copper wire, wound evenly and compactly by automatic machinery. The series coils are form-wound, of copper strap, thoroughly insulated. The complete coil is soaked with insulating varnish and baked.

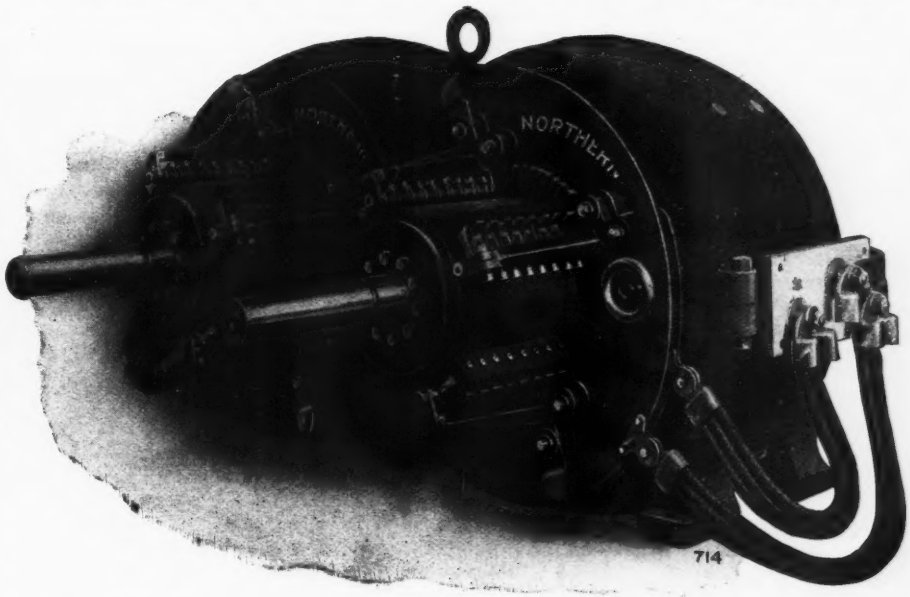


FIG. 1.—TWIN GENERATOR FOR TURBINE ENGINE, 200 KILOWATTS, 900 REVOLUTIONS PER MINUTE.

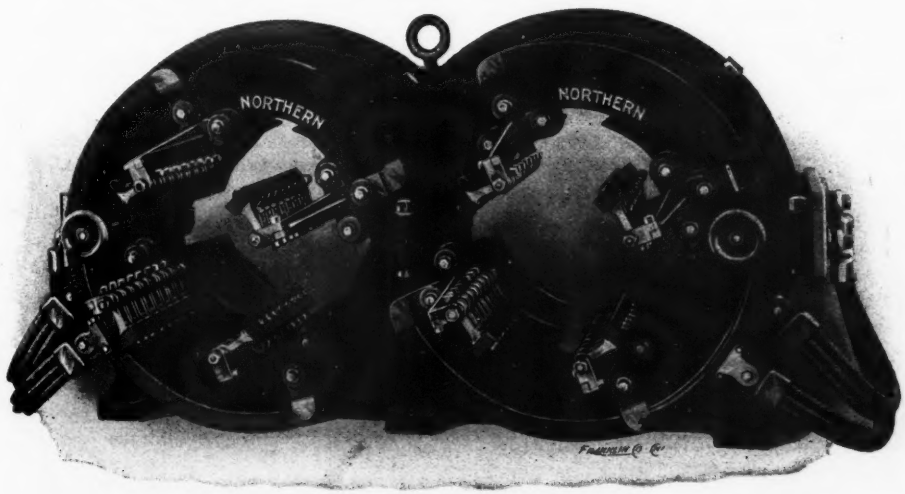


FIG. 2.—TWIN FIELDS, BRUSHES AND BRUSH-HOLDERS, READY FOR ARMATURE.

One of the special features of the Northern apparatus is in the details of the pole-pieces and the method of mounting them in the frames. The shunt and series coils are secured in place on the pole-piece before it is attached to the field frame. When completed, the pole-pieces are securely and solidly locked in position in the frame. The pole-pieces and coils on all of the large ring type Northern apparatus can be quickly removed entire without disturbing the armature or any other parts of the machine.

The commutators are built from forged segments of pure copper, uniform in density and having the grain in the direction of the length. The insulation is of the best mica, carefully selected and gauged by a micrometer to provide uniformity in all parts of the commutator.

The armature spiders are of cast iron, and the armature core is built up of thin discs of insulated soft steel.

The International Association of Municipal Electricians.

The eighth annual convention of the International Association of Municipal Electricians will be held in the banquet hall of the Hotel Rudolf, Atlantic City, N. J., Wednesday, Thursday and Friday, September 2, 3 and 4, 1903. The following papers have been promised: "The Best Method of Lighting Small Cities," "Classifying of Records of Electrical Departments, and Standard Specifications for Supplies and Contracts," "Importance of the Fire and Police Telegraph Systems." There will also be a topical discussion of line construction, which is expected to bring out all the different ideas of the members in relation to this important question.

The question box feature will be utilized this year, and already there is tabulated a large list of questions.

The executive committee has arranged several other features for presentation at this meeting. The last day will be given to the associate members, who will make a general exhibit and explanation of the different material which they manufacture and sell.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

MEXICAN POWER PLANT—The Mexican Light and Power Company has begun construction on a large power station, about ninety miles from Mexico City, for the purpose of furnishing electrical energy for the Mexican capital. This will supply current for lighting, traction and manufacturing purposes. The initial plant, it is said, will have a capacity of 15,000 horse-power. The power-house will be built in the Huauchinango district, state of Puebla. Mr. James Ross, of Toronto, Canada, is president of the company, and Mr. F. S. Pearson is consulting engineer.

ELECTRIC LIGHT AND TRACTION DEAL—It is announced that the Terre Haute Electric Traction Company has been incorporated with a capital of $3,000,000, to take over the property of the Terre Haute Electric Company, capitalized at $1,000,000. The Terre Haute Electric Company owns the only electric lighting and power station in Terre Haute. It also has a power station at Brazil, and is building interurban roads to Paris and Clinton. A line to Brazil, Ind., has been in operation for several years. Of the stock of the new company, $1,000,000 is preferred, while $2,000,000 is common.

MERGER OF LIMA-FORT WAYNE, IND., LINES COMPLETED—The Fort Wayne, Logansport, La Fayette & Lima Traction Company, with a capital stock of $7,500,000, has filed articles of incorporation at Indianapolis, Ind. This is a merger of electric railroad interests which has been expected for some time. The incorporators are those who recently purchased the Fort Wayne city lines, and include Henry C. Paul and Stephen B. Fleming, of Fort Wayne; J. L. Jones, Bayard Henry and Randall Morgan, of Philadelphia; G. F. McCulloch and Hugh McGowan, of Indianapolis; James and Charles Murdock, of La Fayette. The consolidation includes the Fort Wayne city street railway lines, the Logansport city lines, and the La Fayette city lines; the interurban line between Logansport and Wabash, and the Fort Wayne, Lima & Van Wert line, now in progress of construction.

LIGHT AND POWER PLANT ON THE ANIMAS RIVER, COLORADO—Plans are under way for an electric light and power enterprise at the Baker's Bridge section of the Animas River, above Durango, Col. A party of capitalists and engineers assembled recently in Durango, Col., for the purpose of visiting the site and planning for the development and construction. The following parties are named as being interested in this project: Mark Watser, W. L. Hereth, B. Frank Schmid and Fred C. Schmid, of Indianapolis; N. M. Meyers, of Shelbyville; J. W. Adams, of Chattanooga, and P. J. Brown and P. H. Scott, of Denver. A force of men has been put at work at Baker's Bridge, grading and making other preliminary arrangements. The capitalization of the company is $3,000,000, and it is expected that this sum will be expended within the next three years. It is calculated that the enterprise will furnish light and power to points within a radius of from fifty to seventy-five miles, covering all the mining and milling sections of the San Juan country.

INDEPENDENT TELEPHONE COMPANY SEEKS FRANCHISE IN NEW YORK—The Independent Telephone Company has obtained from Supreme Court Justice Clark a writ directing Commissioner Monroe, of the Department of Water Supply, Gas and Electricity, New York city, to show cause why a peremptory mandamus should not be issued compelling him to grant to the company a permit to open the streets. It is alleged that this company was organized in 1899, with a capital of $100,000, with the privilege of increasing it to $20,000,000. The plans are said to be to run a line over Long Island to Montauk Point, and north in New York city to Rouse's Point, and also in the various boroughs comprising Greater New York, installing some 100,000 telephones in Manhattan. The company claims to have obtained the necessary franchise under article V of the New York State Transportation Laws. Commissioner Monroe refused to grant the necessary permit on the ground that the new city charter had repealed the law, and vested the granting of franchises in the board of aldermen.

FINAL ORGANIZATION OF THE PUBLIC SERVICE CORPORATION—The following officers and executive officials have been announced to take over the management of the Public Service Corporation. This company has absorbed all the trolley, electric light and gas companies in the northern part of New Jersey. President, Thomas N. McCarter; first vice-president, Randal Morgan, vice-president of the United Gas Improvement Company, of Philadelphia; second vice-president, Colonel A. R. Kuser, president of the Kuser Company, of Trenton; third vice-president, A. B. Carlton, president of the United Electric Company. The directors are for three years, A. J. Cassatt, John F. Dryden, Thomas Dolan, George R. Gray, A. R. Kuser, Randal Morgan, Thomas N. McCarter, John J. Waterbury. Fort two years, Edward T. Bell, Hugh H. Hamill, William C. Heppenheimer, Lewis Lillie, John F. Shanley, Charles A. Sterling, Leslie D. Ward and P. F. Wauser. For one year, Samuel T. Bodine, Thomas C. Barr, David Baird, Walton Clarke, E. B. Gaddis, U. H. McCarter, F. W. Roebling and E. F. C. Young. Secretary, Fred. Evans, of Newark; general counsel, Frank Bergen, of Elizabeth; manager of the gas department, H. Whitcomb; manager of the electrical department, W. W. Wheatley; comptroller, Percy S. Young, of Jersey City; purchasing agent, I. A. Pearson; superintendent of supplies, A. D. Ball, of Newark; general auditor of street railway accounts, E. B. Hibbs, of Jersey City; general auditor of gas accounts, M. E. Johnston, of Newark; general auditor of electric accounts, E. J. Allegarth, of Newark.

TELEPHONE AND TELEGRAPH.

DES MOINES, IOWA—The Modern Telephone Company will establish an automatic exchange at Burlington.

MARSHALLVILLE, N. C.—The Marshallville Telephone Company has been incorporated with M. K. Lee, H. B. Marsh and others.

HOWARD, MO.—A new telephone line is to be built from Armstrong to Steinmetz, where it will connect with the Glasgow and Fayette lines.

STAMFORD, N. Y.—The Hudson River Telephone Company is now at work on the extension of its long-distance lines from Kingston to Oneonta.

McARTHUR, OHIO—The Home Telephone Company has arranged to connect with the Siverly Creek Telephone Company from Creola to Stella.

STOCKTON, MO.—The Stockton & Filley Telephone Company has been organized and will build a line to connect with El Dorado through the Liston line.

IRON MOUNTAIN, MICH.—The Michigan Bell Telephone Company has completed its long-distance line to Amasa, and the same is now open for use.

JERSEY CITY, N. J.—The Garrett County Telephone Company has contracted for thirty-five miles of new telephone lines. The main line will touch Bittlinger, New Germany and Avilton, in Garrett County.

WASHINGTON, N. J.—A new telephone company, known as the Merchants & Farmers' Company, has recently been organized in Hunterdon County. The line connects every town in the county, south of Clinton.

CHARLESTOWN, W. VA.—C. C. Gaver, of Hillsboro, Va., was granted a franchise recently for the Old Dominion Telephone Company to erect lines to Harper's Ferry. The company, it is stated, will connect with the United Telephone and Telegraph Company's lines.

CLEVELAND, OHIO—Stockholders of the Federal Telephone Company, of Cleveland, met at Orange, N. J., recently, and adopted a proposition to reduce the par value of capital stock from $100 to $10, making the stock now $1,000,000 instead of $10,000,000. A bond issue of $6,500,000 was also ordered. The object is to provide for the lifting of a $4,000,000 debt.

ELECTRICAL SECURITIES.

Dufing the middle of the week there was a decided turn in the ruling conditions in the stock market. Prices are at least better than those which prevailed at the end of last week. While there is still plenty of evidence that the bear interests are very much in control of market fluctuations, the beginning of the end of this possession is felt in many directions to have come about. While there was little apprehension, notwithstanding the steady decline of prices since January, the turning point has been the means of restoring any want of confidence which resulted from the untoward conditions just passed through. Until the monetary outlook is more definitely settled, and there is a definite idea as to the extent of crop improvement, it can hardly be expected that any protracted upward tendency will prevail, but conservative interests are already working on the assumption that such will be the case.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JUNE 13.

New York:	*Closing.*
Brooklyn Rapid Transit	58⅛
Consolidated Gas	197
General Electric	180½
Kings County Electric	200
Manhattan Elevated	137
Metropolitan Street Railway	127
New York & New Jersey Telephone	161
Westinghouse Manufacturing Company	180

The directors of the Western Union Telegraph Company have declared the usual dividend of 1¼ per cent, payable July 15 to stockholders of record June 20. The company makes the following statement of earnings for the last quarter of the fiscal year, partly estimated: Surplus, April 1, 1903, $12,515,340.96; net revenues, quarter ending June 30, $2,000,000, a total of $14,515,340.96; $1,503,313.75 was paid out in interest and dividends, leaving a total surplus of $13,012,027.21.

Boston:	*Closing.*
American Telephone and Telegraph	151¼
Edison Electric Illuminating	249
Massachusetts Electric	84½
New England Telephone	135
Western Telephone & Telegraph preferred	93½
Philadelphia:	*Closing.*
Electric Company of America	8⅝
Electric Storage Battery common	65
Electric Storage Battery preferred	65
Philadelphia Electric	6⅛
Union Traction	45
United Gas Improvement	89¼

The United Gas Improvement directors have declared the regular quarterly dividend of $1 per share, payable July 15 to stock of record June 30.

Stock of the Electric Storage Battery Company to the amount of $15,795,700, all common, has been added to the trading list of the New York Stock Exchange.

Chicago:	*Closing.*
Chicago Telephone	130
Chicago Edison Light	150
Metropolitan Elevated preferred	66
National Carbon common	24½
National Carbon preferred	94
Union Traction common	4
Union Traction preferred	33

At the annual meeting of the stockholders of the Chicago Edison Company, an increase in the capital stock from $10,000,000 to $15,000,000 was authorized. The old board of directors was re-elected.

LEGAL NOTE.

AIR-COOLED TRANSFORMER CASE—A decree has been obtained in the United States Circuit Court, Southern District of New York, June 4, 1903, on the Moody patent 591,869, in the suit of the General Electric Company, complainant, *vs.* the Wagner Electric Manufacturing Company, *et al*, defendants. This decree finds that Letters Patent No. 591,869, issued on October 19, 1897, to the General Electric Company, as assignee of Walter S. Moody, for an electrical transformer, is good and valid in law as to claims 4, 5, 6, 7 and 11, and that the General Electric Company is entitled to the exclusive right in and to the said Letters Patent, and that the Wagner Electric Manufacturing Company has violated the exclusive rights of the complainant under these claims. Also, the decree finds that an injunction should be issued against the defendants, permanently restraining them from putting into practice the inventions or improvements specified in these claims.

ELECTRIC LIGHTING.

DES MOINES, IOWA—Union is to have an electric light plant.

MOULTON, IOWA—An electric light plant is to be installed here.

DALLAS, TEX.—Longview is to have an electric light plant and an up-to-date water system.

LYON FALLS, N. Y.—At a special election it was voted to put in an electric light plant in this village. A stock company will be formed, and the electricity will be transmitted from a power situated in Lyonsdale.

KENNEBUNK, ME.—At a town meeting it was voted to raise $6,000 for the purpose of erecting a building for the town's electric light plant, lately destroyed by fire, and for the purpose of buying the necessary equipment.

MACON, GA.—A corporation has been organized in Milledgeville which proposes to put 10,000 horse-power into Macon from the Milledgeville plant. The new company is known as the Milledgeville Electric Company, and will harness the water power at Furman Shoals, on the Oconee River. A dam will be built at the falls, to be thirty-five feet high. The falls are twenty-five feet.

PERSONAL MENTION.

MR. W. T. JACKSON, of the Cincinnati office of G. M. Gest, has been spending a week in New York city.

MR. JOHN S. SPEER, general manager of the Speer Carbon Company, St. Marys, Pa., paid a flying visit to New York city.

MR. E. L. BEMISS, general manager of the United Railways and Light Company of America, Richmond, Va., was a visitor to New York city last week.

MR. ISAAC L. RICE, president of the Consolidated Railway, Electric Lighting and Equipment Company, is making a trip to Europe. A number of interests pertaining to the companies with which Mr. Rice is connected will probably detain him several months on the other side.

MR. BARTH VON WEHRENALP and Mr. Hubert M. Dietl, telephone engineers of Vienna, are spending a few months in this country studying telephone conditions with a view to improvements in their own country and city. Vienna, with a population of 1,800,000, has only a telephone service of 15,000 subscribers. This proportion, it is the belief of these engineers, can be greatly increased.

MR. U. N. BETHELL, vice-president and general manager of the New York Telephone Company; Mr. John J. Carty, chief engineer of the same company; Mr. John C. Reilly, general manager of the New York & New Jersey Telephone Company; Mr. B. S. Barnard, of the Standard Vitrified Conduit Company, and Mr. A. L. Salt, of the Western Electric Company, were among the guests of Mr. H. L. Shippy on board his steam yacht Zara for the week-end party beginning Friday, June 12. A sail to Shelter Island was enjoyed.

MR. WILLIAM BURLINGHAM has accepted an appointment as chief engine-designer with the B. F. Sturtevant Company, of Hyde Park, Mass., resigning a position in the United States Inspection Office with the William R. Trigg Company, of Richmond, Va. Mr. Burlingham has previously been associated with the Bath Iron Works, the General Electric Company, the Southwark Machine and Foundry Company, and the Newport News Ship-Building and Dry-Dock Company. He has also served on Mr. T. A. Edison's staff at the East Orange laboratory and is a graduate of the Worcester Polytechnic Institute.

MR. HENRY L. SHIPPY, treasurer of the John A. Roebling's Sons Company, of New York, has chartered the fine steam yacht Zara for this season, and is giving a number of week-end yachting parties during the period preceding the international yacht races. Mr. Shippy is a member of the New York Yacht Club and the Zara of course flies the colors of this club. Commodore Shippy with his yacht rescued the owner and guests of the capsized schooner Estelle on Monday of this week. The rescue was promptly and gallantly made, all of the people on the schooner being taken on board the Zara in a few minutes after the accident.

NEW INCORPORATIONS.

BUFFALO, N. Y.—Globe Power Company. $200,000.

SOUR LAKE, TEX.—Light and Power Company. $10,000.

FRANKFORT, KY.—Interstate Electric Company. $5,000.

SIOUX CITY, IOWA—Hurley Telephone Company. $2,000.

LOGANSPORT, IND.—Roann Telephone Company. $15,000.

MARTINEZ, CAL.—Pinole Light and Power Company. $25,000.

KALAMAZOO, MICH.—The Macon Telephone Company. $3,000.

MADISON, IOWA—Battle Creek Farmers' Telephone Company. $3,000.

DILLONVALE, OHIO—The Dillonvale Telephone Company. $10,000.

PEN ARGYLE, PA.—People's Gas Light and Fuel Company. $50,000.

MINNEAPOLIS, MINN.—Western Electric Telephone System. $500,000.

WASHINGTON, D. C.—Collins Marine Wireless Telephone Company. $1,000,000.

DOVER, DEL.—The American Development and Construction Company. $1,000,000.

NORTH ADAMS, MICH.—The Litchfield Farmers' Mutual Telephone Company. $2,000.

NEW CASTLE, IND.—The Sulphur Springs Cooperative Telephone Company. $7,000.

TRENTON, N. J.—The Dallas Electric Company. Increased from $5,000 to $4,500,000.

WALWORTH, WIS.—The Walworth Telephone Exchange Company. Increased to $2,200.

SPRINGFIELD, ILL.—Eureka Telephone Exchange Company. Increased from $2,500 to $5,000.

JOLIET, ILL.—The Fisher Construction Company. $50,000. Incorporators: H. A. Fisher, F. G. See and F. E. Fisher.

CAMARGO, ILL.—Home Telephone Company. $46,000. Incorporators: Eugene Rice, G. C. Jeffers, G. C. Wisemann.

SPRINGFIELD, ILL.—Karas Electric Company. $10,000. Incorporators: L. L. Summers, B. S. Summers, Joseph Karas.

PORTLAND, ME.—Hope Valley Clark Automatic Telephone Company. $10,000. Directors: C. J. Burck and O. W. Burck.

MIDDLETOWN, N. Y.—The Albany-Catskill Electric Railway Company. $350,000. Directors: J. M. and T. M. Sheehan, of Newburgh.

LINCOLN, NEB.—The Park & Valley Telephone Company. $1,000. Incorporators: W. E. Whitney, W. L. Cramer, Joseph Murray.

COLLINSVILLE, CT.—The Collinsville Electric Light Company. $5,000. Incorporators: J. B. Lougee, J. D. Andrews and E. A. Perkins.

BOONE, IOWA—The Ogden Telephone Company. $25,000. Incorporators: Earl Billings, Dr. E. H. Melott, W. O. Whitehead and F. J. Mullen.

CAMDEN, N. J.—Camden & Atlantic Telephone Company. $200,000. Incorporators: Wilfred B. Wolcott, C. E. Wilson and Norman Grey.

CHOUTEAU, MONT.—The Montana Telephone Company. $2,400. Incorporators: C. H. Drake, F. D. Kingsbury, C. R. Scoffin, J. C. McCuaig.

BUFFALO, N. Y.—The Buffalo & Batavia Construction Company. $10,000. Directors: Spencer Kellogg, George L. Lewis and Stuart R. Mann.

CLEVELAND, OHIO—Williams Electric Company. $10,000. Incorporators: P. E. Hintz, L. B. Spanner, E. P. Kern, C. M. White, H. H. Hammond.

FARIBAULT, MINN.—The Faribault Gas and Electric Company. $250,000. Incorporators: B. W. Cowperthwaite, John Haug and E. F. Preston.

ADENA, OHIO—Adena Exchange Telephone. $5,000. Incorporators: J. W. R. Smith, W. H. Thompson, Milton Hall, G. E. Ickes, J. G. Ickes.

ALBANY, N. Y.—Wawayanda Telephone Company. $2,000. Incorporators: H. J. Shelly, Middletown, N. Y.; H. T. Stoge, James McVeigh, New Hampton, N. Y.

JERSEY CITY, N. J.—The Northern Jersey Light, Heat and Power Company. $100,000. Incorporators: George Francis O'Neill, Joseph Wehrle and Thomas Boyle.

WINDOM, MINN.—The Windom Mutual Telephone Company. $45,000. Incorporators: M. N. Cadwell, H. E. Hanson, John J. Rupp, Matt Miller, Henry Sherman.

JERSEY CITY, N. J.—Kansas City Railway and Light Company. $25,000,000. Incorporators: K. K. McLaren, Louis B. Dailey, Joseph M. Mitchell, all of Jersey City, N. J.

BRYN MAWR, PA.—Upper Merion Electric Light Company. $10,000. Incorporators: Edward H. West, C. R. Fritcher and Herbert E. Harris, all of Harrisburg.

SOUTH BEND, IND.—The Indiana Western Construction Company. $100,000. Directors: W. W. Babcock, E. F. Gaffney, Clarence Sandage, H. C. Smith and Harry Long.

HARRISBURG, PA.—Masontown Light, Heat and Power Company. $10,000. Directors: J. V. Hoover, D. R. Anderson, F. A. Maddas, L. G. Sterling, W. I. Crawford.

CINCINNATI, OHIO—The General Light, Heat and Power Company. $20,000. Incorporators: Thomas S. Spivey, W. C. Hattersley, W. E. Arnold, W. Scott and G. A. Hattersley.

COLUMBUS, OHIO—The South Charleston Home Telephone Company. $50,000. Incorporators: S. B. Rankin, Alex Renick, Edwin R. Sharp, Frank L. Beam, Frank A. Davis.

NORWOOD, N. Y.—The Norwood Telephone Company. $25,000. Incorporators: F. L. Smith, W. J. Fletcher, A. C. Healy, George Harris, W. D. Fuller, L. E. Ellison, J. E. Boynton.

WASHINGTON C. H., OHIO—The Columbus & Washington C. H. Railroad Company. $10,000. Incorporators: Frank R. Pomerene, Richard Emery, Frank Johnson, and others.

MONTICELLO, IND.—Northern Indiana Independent Telephone Company. $10,000. Directors: John E. Yarling, Thaddeus E. Hanway, Andrew A. Adams, Samuel Tomlinson and Joseph M. Bergman.

KINGSTON, N. Y.—The Ulster Electric Light, Heat and Power Company. $30,000. Directors: William A. Hanna, A. H. Eckert, J. G. Hanna, D. Hanna Corns, John T. Wadhams and Charles Davis, of Saugerties.

LORAIN, OHIO—The Lorain Electrical Construction Company. $10,000. Incorporators: B. S. Smith, E. P. Barries, Theodore Gow, G. S. Shoupe, Henry Sandrack, Harian Eckler, Henry Johns and L. H. Mandeville.

COLUMBUS, OHIO—Elyria, Lagrange & Southern Traction Company. $10,000. Incorporators: F. H. Foster, J. M. Starr, H. J. Eady, William Heldmyer, I. A. Freeman, P. K. Clark, W. B. Johnson and George H. Chamberlain.

GUTHRIE, OKLA.—The Thomas Telephone Company. $10,000. Incorporators: R. A. Smith, F. T. Crowley, J. E. and Oscar Zimmerman, of Lawson, Mo.; D. L. Kinzer, Holt, Mo.; James T. Riley, Liberty, Mo.; O. F. Mitchell, of Thomas.

FORT WAYNE, IND.—The General Construction Company. $50,000. Incorporators: George W. Beers, S. M. Foster, Charles McCulloch, William E. Moseman, S. G. Fisher, Louis Fox, William P. Breen, W. J. Vesey and C. R. Colmey.

SHENANDOAH, PA.—Shenandoah & Suburban Electric Street Railway Company. $30,000. Directors: D. J. Langton, M. Mellet, H. M. Bradigan, J. W. Curtin, T. M. Stout, J. S. Housenick, of Shenandoah, and the Hon. C. A. Snyder, of Pottsville.

WASHINGTON, D. C.—United States Lighting and Traction Company. $2,000,000. Incorporators: Edward White, W. A. White, W. I. Francis, Washington, D. C.; Herbert L. Stillman, West Acton, Mass., and Thomas W. Bickwell, Providence, R. I.

ELECTRIC RAILWAYS.

LANSING, MICH.—Articles of incorporation of the Washtenaw Home Telephone Company, of Ann Arbor, capitalized at $250,000, have been filed.

COLUMBUS, OHIO—The Interstate Traction Railway Company, of Dayton, has been incorporated with a capital of $100,000. The company will build an electric line from Indianapolis to Dayton.

MAYSVILLE, KY.—A company has been organized to build an electric road from this place to Mount Olivet. John W. Duly, of Mount Olivet, is president. The road is expected to cost $300,000.

MINERAL WELLS, TEX.—At a meeting of the county council, the Independent Telephone Company was granted a twenty-five-year franchise to build and operate a telephone exchange in this city.

PEORIA, ILL.—The Glen Oaks & Prospect Heights street car line has been sold to the Central City Company for $300,000. This consolidates all the city lines, with the exception of one, under one management.

DES MOINES, IOWA—The Western Iowa Interurban Railway Company, to build an electric road between Des Moines and Council Bluffs, has been organized with a capital of $1,000,000. Work is to begin at once.

INDIANAPOLIS, IND.—The Brazil Telephone Company has been incorporated with a capital of $60,000. The directors are: P. D. C. Ball, St. Louis; Major Collins, Henry D. Falls, O. E. Adams and Morton E. Decker, of Brazil.

CLEVELAND, OHIO—The St. Joseph, Parkville & Kansas City Railway has been chartered with a capital of $5,000,000. The company is to build an electric road from St. Joseph, Mo., to Kansas City, via Atchison and Leavenworth, Kan.

ALBANY, N. Y.—The Amityville & Huntington Railroad Company, with principal office in Brooklyn, has been incorporated with a capital of $250,000 to operate a street surface electric road over fourteen miles long from Amityville to Huntington.

LA CROSSE, WIS.—The La Crosse & Black River Falls Railway Company's road will, it is said, cost at the rate of $25,000 a mile, or a total of $1,260,000. The line will be in operation by January 1, 1906, and will extend from La Crosse to Black River Falls.

SPRINGFIELD, ILL.—The Springfield, Moweaqua & Mattoon Railroad Company has been incorporated with a capital stock of $25,000, the principal office at Sullivan, Ill. A road will be constructed from Springfield by way of Moweaqua and Sullivan to Mattoon.

ALBANY, N. Y.—The Westchester Traction Company, of Ossining, has obtained from the State Railroad Commission approval of an increase of capital stock from $300,000 to $1,500,000. The company proposes to build an extension to Portchester, Westchester County.

BANGOR, ME.—An electric railroad from forty to fifty miles in length is to be built in Washington County, close to the coast, where the railroad does not extend. It will do a passenger, freight, mail and express service. It is expected that work will begin shortly.

GLASGOW, KY.—The Glasgow, Burkesville & Cumberland Valley Traction Company has been incorporated with a capital of $500,000. The company will build an electric railway from Glasgow via Edmonton to Burkeville, and probably southward to some point in Tennessee.

HARTFORD, CT.—The Buhl-Kimberley Company, of Bridgeport, has ben chartered with $5,000,000 capital, to construct railways, lighting plants, etc., and to acquire the same. The incorporators are: Ashley T. Cole, Richard F. McKiniry and W. J. Bagnell, all of New York.

CINCINNATI, OHIO—The Southern Traction Company, of Indiana, capital $20,000, has filed articles of incorporation. It proposes to build a line from Columbus, through Hanover, to Madison. The incorporators are Henry C. Rominger, Edward E. Goder and W. T. Hubbard, of Indianapolis.

UNIONTOWN, PA.—A mortgage for $300,000, given by the Webster, Monessen, Bellevernon & Fayette City Railway Company to the Fayette Title and Trust Company, has been placed upon record. The mortgage covers the entire line, that portion already built, and such others as shall be built.

CINCINNATI, OHIO—The Loveland & Cincinnati Traction Company has been incorporated with a preliminary capitalization of $50,000. The company expects to build a road from Loveland to Madeira, Ohio, where it will connect with the Cincinnati & Columbus Traction Road, now being built.

COLUMBIA, S. C.—The Columbia Electric Street Railway, Light and Power Company has completed arrangements for the issue of $1,000,000 of five per cent gold bonds, to be used for taking up previous debts, the better equipment of the road, and for acquiring the property of the Columbia Gas Light Company.

MANITOWOC, WIS.—It is stated that an electric road will be built, connecting Manitowoc and Fond du Lac. The line is to be on the east shore of Lake Winnebago, and will run through the villages of Pabst Harbor, Pike, Tayceedah, Peebles, Columbia, Park, Calumetville, Brothertown, Stockbridge and Chilton.

SPRINGFIELD, ILL.—Articles of incorporation have been filed by the Decatur, Springfield & St. Louis Railway Company, with a nominal capital stock of $500,000. The principal office is to be at Decatur. The object is to build an electric road from Decatur by way of Springfield and Corlinsville to East St. Louis.

GRAND RAPIDS, MICH.—Articles of incorporation of the Grand Rapids Electric Railway Company, with a capital of $2,000,000, have been filed with the Secretary of State. The company will build electric lines in various portions of northern Michigan, including a line from Grand Rapids across the state to Lake Huron.

MUNCIE, IND.— The Union City, Winchester & Muncie Traction Company has been consolidated with the Greenville & Union City Traction Company, the new company to be known officially as the Dayton & Muncie Traction Company. The company owns the road that is being constructed between Muncie and Dayton, through Farmland, Winchester, Greenville and other towns.

CLEVELAND, OHIO—The Cleveland & Sharon Traction Company has executed a mortgage to the Eastern Trust Company to secure an issue of $2,000,000 of twenty-five-year five per cent gold bonds. The company is chartered to build a trolley line from Middlefield, in Geauga County, through Kinsman, in Trumble County, to Sharon, Pa., a distance of forty-one miles, with a branch line from Kinsman to Meadville, about thirty-one miles.

FORT WAYNE, IND.—In the Circuit Court here a receiver has been appointed for the Fort Wayne & Southern Railroad, an electric line operating forty miles of lines between this city and Wabash, Ind. Application for the receivership was made by J. Manchester Haynes, president of the Augusta, Me., Trust Company, which holds $300,500 of the Southwestern's bonds. S. L. Nelson, general manager of the road, was named as receiver.

LOUISVILLE, KY.—Articles of incorporation have been filed in Indianapolis by the Ohio Valley Electric Railway Company, with a capital of $10,000. The incorporators are Louis Schneck, of Seymour; E. G. Connette and W. H. Holbrooke, of Syracuse, N. Y.; George H. Holzbog and George H. Voigt, of this city. The object of the company is to construct an electric railway from Jeffersonville to Madison, by way of Charlestown and New Washington, and from Jeffersonville to Henryville, by way of Sellersburg and Memphis, Ind., the latter line to connect with the road now building from Indianapolis to Louisville.

ATTICA, IND.—The Western Electric Railroad Company, of Logansport, has filed articles of incorporation. The company is capitalized at $150,000, and will build an electric line from Logansport to Fowler, Benton County, and a system that will pass through Benton County to Crown Point and Hammond in Lake County, Rensselaer, Winamac, Rochester, North Judson, Knox, Plymouth, La Porte, Michigan City and Valparaiso. The estimated length of the system is 150 miles. The directors are: Newland T. DePauw, of Albany; Henry B. Smith, of Hartford City; William M. Elliott, of Logansport; Emory B. Sellers, of Monticello, and George E. Ross, Jr., of Logansport.

INDUSTRIAL ITEMS.

THE EWING-MERKLE ELECTRIC COMPANY, St. Louis, Mo., is sending the "Green Book" to its patrons and the electrical field generally. This "Green Book" gives a detailed list of the immense stock of supplies and apparatus which the Ewing-Merkle company carries.

THE STANDARD ELECTRICAL MANUFACTURING COMPANY, Niles, Ohio, is kept busy supplying the market with its incandescent lamps. The company is making a specialty of its "White Star," "Red Star" and "Green Star" lamps. Illustrated literature will be sent to interested parties on request.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., and Rochester, N. Y., has recently sold a switchboard and telephone apparatus to the Concord Telephone Company, Concord, Ill. The Consolidated Telephone Company, Gridley, Ill., has also purchased an equipment from the company.

THE THOMAS E. CLARK WIRELESS TELEGRAPH-TELEPHONE COMPANY, Detroit, Mich., will have an interesting exhibit at the convention of the Independent Telephone Association of the United States, in Chicago, June 24 and 25. This company manufactures wireless telegraph instruments for general service.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, will be pleased to send to interested parties its new catalogue, descriptive of flange joint gaskets. This company also makes a specialty of asbestos and magnesia products in the shape of roofing and building material, non-conducting coverings, steam packings, fireproof cements, "Vulcabeston" for electrical, steam and mechanical purposes, moulded mica insulation, electric heating apparatus, etc.

THE HYDRA BATTERY COMPANY, 70 and 72 Reade street, New York city, with factories at New York, Berlin, Paris and Vienna, is constantly receiving testimonials commendatory of its batteries for automobile and launch service. The company states that the United States Signal Service, after exhaustive tests, has adopted these batteries for exclusive use. The Hydra battery is made under a patented process, and the results accomplished have made it a very popular primary cell.

GEORGE T. EYANSON, Philadelphia, Pa., trading as George T. Eyanson & Company, has sold his entire rights, title and interest in the manufacturing plant or business operated by George T. Eyanson & Company, including all machinery, tools, stock, fixtures and good will, and all business except back accounts, to the George T. Eyanson Company, Incorporated. All the debts of George T. Eyanson & Company will be paid by George T. Eyanson, to whom statements of accounts should be sent as early as possible.

THE C. W. HUNT COMPANY, West New Brighton, N. Y., has shipped on the steamship Roseley, which left New York last Friday for various South African ports, what will probably be the first electric locomotive to enter that country. This locomotive is shipped to the order of the De Beers Consolidated Mines, Limited, for use in one of its plants. It is of the latest storage battery type, standard throughout, with the exception of the gauge of the wheels, which is special to suit the track now in use at the mines.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., has just issued a booklet entitled "Noiseless Gearing." This company manufactures a specially prepared raw hide gearing for transmitting power noiselessly, directly, cleanly, safely and without loss. This material is especially adapted for high-speed machinery. The booklet gives some interesting information on this subject, and outside of its usefulness in this direction, is attractive enough to ensure preservation. The company will be pleased to send these on request.

THE AMERICAN VITRIFIED CONDUIT COMPANY, New York city, has already shipped to the Keystone Telephone Company, of Philadelphia, Pa., 1,200 carloads of duct. The underground system of the Keystone company will involve an expenditure of approximately $3,000,000, the company making it a point to install sufficient duct capacity to take care of its increases for many years to come. This is one of the most complete conduit installations in the world, and the American Vitrified Conduit Company is supplying all of the material.

THE MARSHALL-SANDERS COMPANY—Mr. L. W. Kittman, general traveling salesman for the Marshall-Sanders Company, Boston, Mass., has just returned from another extended trip through the central and western states, and reports the sales and popularity of the Marshall-Sanders goods everywhere on the increase among old customers, and he has added a large number of new firms to the already extended clientage of the company. The Marshall-Sanders Company also reports a phenomenal business in the sale of its well-known push-button switches, its production department having to be constantly increased to keep pace with the demand.

THE D. M. STEWARD MANUFACTURING COMPANY, Chattanooga, Tenn., manufacturer of "Lavite" insulating materials, has published an interesting and instructive booklet entitled "Mechanical and Electrical Properties of Lavite," by Henry Bewlay. He outlines the mechanical and electrical properties of "Lavite," gives a table showing the specific gravity and weight of various insulating materials, the mechanical strength of "Lavite," a chapter on "The Traverse Strength of Materials," a chapter on "The Compressive Strength of Various Materials," and a chapter on "The Electrical Properties of Lavite and the Disruptive Strength of Dielectrics."

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has recently closed another large contract for the installation of chloride accumulators on the Pacific coast. The Seattle Electric Company which in April, 1903, closed a contract for the installation of a battery at the Fremont substation for use in regulating the railway load, has now contracted for 154 cells to be installed in the Post street station at Seattle, to be used in connection with the lighting load. These elements will have a capacity of 14,400 ampere-hours, and aside from caring for the peak, one of the most important features in connection with the installation is its value as a reserve. The containing-tanks for this battery will be of sufficient size to allow an increase of twenty-five per cent in capacity.

THE SWEDISH-AMERICAN TELEPHONE COMPANY, Chicago, Ill., has recently closed contracts with the following named telephone companies for their complete equipment: The Rural Union Telephone Company, at Livermore, Iowa, with exchanges at Livermore, Humbolt, Bode, Harding, Rutland and Pioneer, Iowa; Dedham Telephone Company, Dedham, Iowa; People's Mutual Telephone Company, Latimer, Iowa; Golden Rod Telephone Company, Osceola, Neb.; M. L. Reynolds Telephone Company, Delton, Wis.; J. A. Murray, North Freedom, Wis.; Farmers and Merchants' Telephone Company, Runnells, Iowa; Rowan Rural Telephone Company, Rowan, Iowa; Auburn Telephone Company, Auburn, Neb.; West Lawn Telephone Company, Leeton, Mo.; Interstate Telephone Company, Modale, Iowa; Peet & Company, Swea City, Iowa; Brown Supply Company, Coffeyville, Kan.; Farmers' Mutual Telephone Company, Hepburn, Iowa; Armstrong Telephone Company, Yatesboro, Pa.; Butternut Valley Telephone Company, New Berlin, N. Y.; D. H. Holt, Bronson, Kan.; Judson Milling Company, Judson, Ind.; Wilsonville Telephone Company, Stockport, Iowa; Epworth Rural Telephone Company, Cleghorn, Iowa; Arion Telephone Company, Arion, Iowa; Osmond Telephone Company, Osmond, Neb.; Potosi Telephone Company, Potosi, Mo.; Landessville Mutual Telephone Company, Landessville, Ind.; Kilbourne Telephone Company, Kilbourne, Wis.; Pierson Telephone Company, Pierson, Iowa; Rector Cooperative Telephone Company, Rector, Ark.; La Fontaine Telephone Company, La Fontaine, Ind.; Orange Mutual Telephone Company, Orange, Ind.; Viborg & Centerpoint Telephone Company, Viborg, S. D.; Tracy Telephone Company, Bussey, Iowa; New Richmond Telephone Company, New Richmond, Ind.; Sharpesville Telephone Company, Sharpesville, Ind.; Lincoln Mutual Telephone Company, Stuart, Iowa; Cherokee Mill and Elevator Company, Cherokee, Kan.; Deer Creek Cooperative Telephone Company, Deer Creek, Ind.; Camden Telephone Company, Camden, Ind.; Burrows Telephone Association, Burrows, Ind.; Seymour Telephone Company, Seymour, Ill.; Roseville Telephone Company, Roseville, Ill.; Teton Telephone Company, St. Anthony, Ida.; West Bend Telephone Company, West Bend, Iowa; Arlington Telephone Company, Arlington, Ind.; Citizens' Telephone Company, Murrayville, W. Va.; Prairie City Telephone Company, Prairie City, Iowa; Mitchellville Telephone Company, Mitchellville, Iowa; Bedford County Telephone Company, Bedford, Pa.